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U. S. DEPARTMENT OF COMMERCE

BUREAU OF FISHERIES

PROPAGATION AND DISTRIBUTION OF FOOD FISHES

FISCAL YEAR 1928

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BUREAU OF FISHERIES

PROPAGATION AND DISTRIBUTION OF FOOD FISHES

FISCAL YEAR 1928

APPENDIX VIII TO THE REPORT OF THE U. S. COMMISSIONER OF FISHERIES FOR 1928

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PROPAGATION AND DISTRIBUTION OF FOOD FISHES, FISCAL YEAR 1928 [1]

By Glen C. Leach, *Assistant in Charge, Division of Fish Culture*

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INTRODUCTION

During the fiscal year 1928 the bureau was more than ordinarily successful in its work of hatching, rearing, and distributing food and game fishes. From all parts of the country it has received reports of greater production of fish in waters stocked by the bureau, particularly in Pennsylvania, New York, and other Eastern States, where anglers state the trout fishing has improved greatly.

In several sections of the country, it is true, the output of the Government hatcheries has been insufficient to rehabilitate declining commercial fisheries, but it is hoped that all of the obstacles that so far have prevented the complete success of the bureau's work at such places may be overcome soon.

The greatest improvement in fishing conditions has taken place in the localities where cooperative fish nurseries are being operated by the sportsmen themselves, as well as by other organizations, in rearing fish provided by the Bureau of Fisheries. Many delighted owners of small natural or artificial ponds and lakes that have been stocked with fish from Federal hatcheries have reported that, though some of them contained no fish life whatever before being stocked by the bureau, they have provided an astonishing number of food and game fishes.

The efficacy of artificial propagation is evidenced in the rehabilitation of the runs of the commercially valuable salmons of the Pacific coast and Alaska. By making heavy plants of eggs of these species over a period of years, streams that had no native population of the more valuable forms have become self-supporting. The same has been done with the lake trout in certain sections of the Great Lakes. The maintenance of the remnant of the Penobscot salmon run and such slight improvement as it has shown in recent years can be traced to the work of the hatchery at Craig Brook, Me. In the Madison Valley in Montana a magnificent run of Loch Leven trout has been built up to the point where 60 per cent of the eggs produced can be removed and planted in other waters, the remaining 40 per cent being sufficient to provide an adequate stock of fish for the parental waters.

Following is a detailed statement of the progress made in this branch of the bureau's work during the year ended June 30, 1928:

Part 1.—FISH PRODUCTION: PROPAGATION AND RESCUE WORK

SPECIES HANDLED

During the year the propagation and rescue work of the bureau affected 46 species of fish, as follows:

CATFISHES (SILURIDÆ):
Catfishes (Ictalurus sp. and Leptops sp.).
Horned pout (*Amciurus nebulosus*).
SUCKERS (CATOSTOMIDÆ): Buffalo fish (Ictiobus sp.).
PADDLEFISHES (POLYDONTIDÆ): Paddlefish (*Polydon spathula*).
CARP (CYPRINIDÆ):
Common carp (*Cyprinus carpio*).
Goldfish (*Carassius auratus*).

Shad and Herring (Clupeidæ):
Shad (*Alosa sapidissima*).
Glut herring (*Pomolobus æstivalis*).
Salmon, Trouts, and Whitefishes (Salmonidæ):
Common whitefishes (Coregonus sp.).
Cisco (*Argyrosomus artedi*).
Chinook, king, or quinnat salmon (*Oncorhynchus tschawytscha*).
Chum salmon (*Oncorhynchus keta*).
Humpback salmon, pink salmon (*Oncorhynchus gorbuscha*).
Silver salmon, coho salmon (*Oncorhynchus kisutch*).
Sockeye, blueback, or red salmon (*Oncorhynchus nerka*).
Steelhead salmon (*Salmo gairdneri*).
Atlantic salmon (*Salmo salar*).
Landlocked salmon (*Salmo sebago*).
Rainbow trout (*Salmo shasta*).
Black-spotted trout, redthroat trout (*Salmo lewisi*).
Loch Leven trout (*Salmo levenensis*).
Lake trout, Mackinaw trout (*Christovomer namaycush*).
Brook trout (*Salvelinus fontinalis*).
Graylings (Thymallidæ): Montana grayling (*Thymallus montanus*).
Pikes (Esocidæ): Common pickeral (*Esox lucius*).
Sunfishes, Black Basses, and Crappies (Centrarchidæ):
Crappie (*Pomoxis, annularis* and *P. sparoides*).
Largemouth black bass (*Micropterus salmoides*).
Smallmouth black bass (*Micropterus dolomieu*).
Rock bass (*Ambloplites rupestris*).
Warmouth bass, goggle-eye (*Chænobryttus gulosus*).
Green sunfish (*Apomotis cyanellus*).
Red-breasted bream (*Lepomis auritus*).
Bluegill sunfish (*Lepomis incisor*).
Common sunfish (*Eupomotis gibbosus*).
Perches (Percidæ):
Pike perch (*Stizostedion vitreum*).
Yellow perch, ringed perch (*Perca flavescens*).
Striped Basses (Serranidæ):
Striped bass (*Roccus lineatus*).
White perch (*Morone americana*).
White bass (*Roccus chrysops*).
Drums (Sciænidæ): Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*).
Cods (Gadidæ):
Cod (*Gadus callarias*).
Haddock (*Melanogrammus æglifinus*).
Pollock (*Pollachius virens*).
Flounders (Pleuronectidæ): Winter flounder, American flatfish (*Pseudopleuronectes americanus*).
Mackerel (Scomeridæ): Common mackerel (*Scomber scombrus*).

COOPERATION WITH STATES AND PRIVATE INDIVIDUALS

At the present time the work of the division of fish culture has two major subdivisions—(1) the routine delivery of fish upon individual applications, together with station distributions of commercial varieties, and (2) cooperation with State and private conservation agencies. It is probable that the latter phase is fully as important as the former as a means of restocking public waters.

The exchange of eggs with many of the States has become routine practice. So far as is possible eggs have been furnished to the States free of cost, particularly in the West, where large harvests have been obtained at field collecting stations. The bureau has operated a pike-perch hatchery on Lake Champlain jointly with the States of Vermont and Pennsylvania. After an inspection of the waters of the States, approximately 200,000 rainbow trout were fur-

nished the State of North Carolina for distribution in the region surrounding the proposed new national park in the Great Smoky Mountains. The services of the bureau's employees were lent to the State of New Jersey for the purpose of carrying on shad work in the Delaware River; to Florida to aid in developing the artificial propagation of the spiny lobster; and to Arkansas for the purpose of establishing a large new hatchery. A close liaison has been maintained with the State of Michigan as a means of making more effective the rehabilitation of the commercial fisheries of that State. The bureau has incubated eggs for West Virginia, and the bureau's cars have aided that State and Maryland in distributing the output of their hatcheries. Close and profitable relations have been maintained with the State of Montana. An important item in this connection was the completion of a large bass and pondfish establishment at Miles City, Mont., under the joint auspices of the bureau and the State.

On the Pacific coast the important work of propagating the Pacific salmons has been facilitated by cooperation in various ways with the States of Oregon and Washington. The bureau is aiding the State of Virginia by furnishing fish for a system of public rearing pools established by that Commonwealth. Connecticut has taken up the propagation of flounders with the assistance of one of the bureau's employees experienced in marine work. The bureau has also received important concessions from many of the States, enabling it to carry on its activities more efficiently. There appears below a table that is indicative of the extent to which the bureau has been able to benefit many States by the outright assignment of fish and eggs.

Assignments of fish eggs to State and Territorial fish commissions, fiscal year 1928

State and species	Number
California: Black-spotted trout	75,000
Colorado: Rainbow trout	50,000
Connecticut: Pike perch	2,000,000
Hawaii:	
Chinook salmon	15,000
Rainbow trout	29,000
Steelhead salmon	40,000
Idaho: Rainbow trout	150,000
Illinois: Rainbow trout	144,000
Iowa:	
Lake trout	50,000
Rainbow trout	309,000
Maine: Lake trout	100,000
Maryland: Loch Leven trout	50,000
Massachusetts: Loch Leven trout	100,000
Michigan: Lake trout	1,753,000
Minnesota: Lake trout	1,982,000
Missouri: Rainbow trout	97,000
Montana:	
Black-spotted trout	1,006,000
Loch Leven trout	2,699,000
Nebraska: Loch Leven trout	100,000
Nevada:	
Brook trout	202,000
Rainbow trout	500,000
New Hampshire:	
Lake trout	600,000
Rainbow trout	137,000
New Mexico:	
Loch Leven trout	1,500,000
Steelhead salmon	75,000
New York:	
Lake trout	400,000
Steelhead salmon	125,000
North Carolina: Rainbow trout	596,000
Ohio: Rainbow trout	201,000
Oregon:	
Black-spotted trout	500,000
Brook trout	464,000
Chinook salmon	11,592,000
Silver salmon	925,000
Sockeye salmon	3,528,000
Steelhead salmon	870,000
Pennsylvania:	
Loch Leven trout	500,000
Pike perch	54,210,000
Rainbow trout	205,000
South Dakota:	
Loch Leven trout	513,000
Steelhead salmon	75,000
Utah:	
Black-spotted trout	150,000
Brook trout	550,000
Loch Leven trout	1,002,000
Washington:	
Black-spotted trout	1,304,000
Chinook salmon	5,000,000
Chum salmon	3,000,000
Lake trout	250,000
Sockeye salmon	828,000
West Virginia: Loch Leven trout	200,000
Wisconsin: Lake trout	1,145,000
Wyoming:	
Black-spotted trout	550,000
Brook trout	255,000
Loch Leven trout	925,000
Rainbow trout	722,000
Total	104,348,000

The bureau has also cooperated with the Department of Agriculture and the Department of the Interior. Heavy assignments of fish have been made to the waters of many of the national forests, under control of the former, and the bureau deems this feature an important part of its duties. The relations with the Interior Department in the conduct of fish-cultural operations in Glacier and Yellowstone National Parks have been mutually helpful. A new hatchery building is being laid out in the Yellowstone Park, and the facilities in that reservation are being further augmented by the construction of rearing ponds at Mammoth Springs. Generous assignments of trout fingerlings for Rainier National Park have been made possible by the willingness of certain game commissioners of the State of Washington to rear the fish at their hatcheries. The bureau has also made plants of fish in waters under the control of the Reclamation Service and the Irrigation Service. An interesting

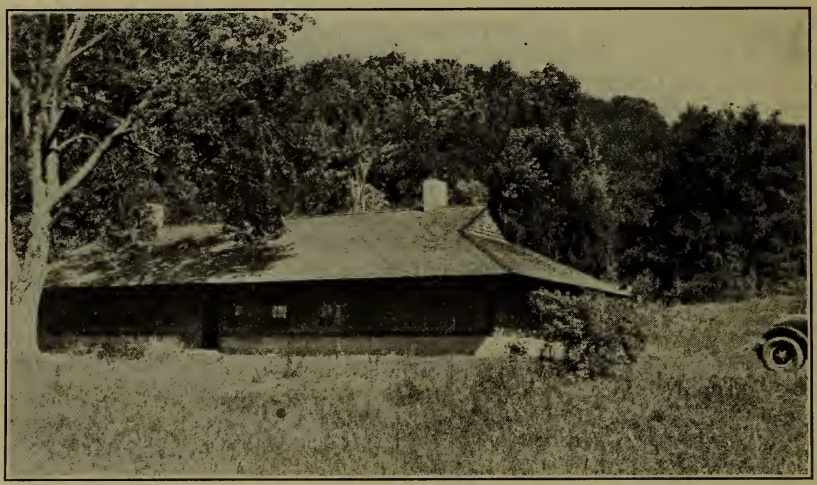

FIGURE 1.—Cooperative fish hatchery at Barneveld, N. Y.

feature has been the supplying to the Chemical Warfare Service of thousands of tadpoles for experimental work.

Cooperation with private individuals and organizations has largely consisted in work with rearing pools and nursery ponds. There appears below a tabulation of this activity showing the number of nurseries in operation, their geographical distribution, and the number of fish assigned. In addition to the two complete hatchery units conducted by a detached employee of the bureau, which were in operation last year, a new establishment of a similar nature was opened near Windber, Pa. The work has been extended to several other States, including Virginia, Massachusetts, and New Jersey. There has been an increase from 55 to 86 in the number of nurseries established by the bureau during the past year. A number of sites that proved to lack proper conditions were inspected, and some sites that were approved have not yet been developed. Advice and suggestions relative to all phases of the nursery pond have been given freely, and in some cases, based upon this information, nurseries have been constructed and operated in conjunction with certain of the

States. The total allotments of fish amounted to 2,675,000, an increase of about 175,000 over last year's assignments.

Cooperative nurseries and rearing ponds established by the bureau in 1928

Locality	Number of fish supplied	Kind
Colorado: Salida	25,000	Brook trout.
Massachusetts: Westfield	8,000	Do.
Michigan:		
Turtle Lake	300,000	Do.
Tustin	20,000	Do.
Gaylord	48,000	Do.
Metamora	15,000	Do.
Ishpeming	25,000	Do.
Alpena	21,000	Do.
Do	4,000	Rainbow trout.
Rogers City	300,000	Lake trout.
Minnesota:		
Eyota	8,100	Brook trout.
La Crescent	400	Do.
Lake City	20,100	Do.
Lewiston	15,000	Rainbow trout.
Red Wing	3,000	Do.
Do	3,000	Loch Leven trout.
Do	10,200	Brook trout.
Rochester	60,000	Loch Leven trout.
Rushford	12,000	Rainbow trout.
St. Charles	19,200	Do.
Do	6,000	Loch Leven trout.
Winona	45,000	Rainbow trout.
Do	43,000	Brook trout.
New Jersey: Paterson	10,000	Do.
New York:		
Barneveld	50,000	Brook-trout eggs.
Do	238,650	Rainbow trout.
Do	30,000	Lake trout.
Watertown	116,000	Brook trout.
Malone	40,000	Do.
Oneonta	39,000	Do.
Arena	21,000	Do.
Pennsylvania:		
Camp Hill	60,000	Do.
Windber	100,000	Do.
Chester	10,000	Loch Leven trout.
Renovo	30,000	Brook trout.
Williamsport	35,000	Do.
Myersdale	25,000	Do.
Connellsville	30,000	Do.
Ligonier	10,000	Do.
Do	10,000	Rainbow trout.
Do	7,200	Do.
Ridgeway	10,000	Brook trout.
Muncy	40,000	Do.
Belleville	20,000	Do.
Altoona	15,000	Do.
Do	5,000	Rainbow trout.
Do	15,000	Loch Leven trout.
Uniontown	10,000	Do.
Do	10,000	Rainbow trout.
Do	10,000	Do.
Scranton	40,000	Loch Leven trout.
Somerset	25,000	Brook trout.
Do	10,000	Rainbow trout.
Williamsport	10,000	Brook trout.
Johnstown	10,000	Do.
Do	10,000	Rainbow trout.
Trout Run	50,000	Brook trout.
Pittston	10,000	Do.
Williamsport	20,000	Do.
Clearfield	25,000	Do.
Do	8,000	Do.
Hazleton	20,000	Do.
Boswell	4,000	Do.
Sharon	4,000	Do.
Conneaut Lake	3,000	Smallmouth black bass.
Vermont:		
Averill	24,500	Brook trout.
Do	30,000	Landlocked salmon.

Cooperative nurseries and rearing ponds established by the bureau in 1928—Con.

Locality	Number of fish supplied	Kind
Virginia:		
Independence	2,000	Brook trout.
Galax	2,000	Do.
Lynchburg	3,000	Do.
Shawsville	5,000	Rainbow trout.
West Virginia:		
Durbin	25,000	Brook trout.
Do	5,000	Rainbow trout.
Tunnelton	15,000	Brook trout.
Wisconsin:		
Arcadia	9,100	Do.
Athelstane	4,500	Do.
Boscobel	15,000	Do.
Eau Claire (2 ponds)	20,000	Rainbow trout.
Do	5,000	Brook trout.
Ellsworth	19,900	Rainbow trout.
Do	10,100	Brook trout.
Elmwood	5,100	Do.
Elroy	2,000	Do.
Do	4,000	Rainbow trout.
Galesville	9,900	Brook trout.
Glenwood City	5,000	Do.
Holmen (2 ponds)	8,000	Do.
Independence	10,000	Do.
La Crosse (2 ponds)	15,000	Do.
Marathon	12,900	Do.
Merrill	22,700	Do.
Osseo	10,500	Do.
Plum City	8,100	Do.
Rothschild	9,900	Do.
Schofield	3,900	Do.
Sparta	3,000	Rainbow trout.
Do	3,000	Brook trout.
Stanley	5,000	Do.
Stevens Point	20,000	Rainbow trout.
Do	3,200	Loch Leven trout.
Tomah	20,100	Brook trout.
Tomahawk	9,900	Do.
Tunnel City	6,000	Do.
Viroqua	8,000	Loch Leven trout.
Wausau	9,900	Brook trout.
Westby	8,000	Loch Leven trout.
	2,675,050	

Cooperative fish-cultural projects, involving as they do the selection of sites, inspections from time to time while the fish are being fed, assistance in the distribution of fish, and general supervision, have developed beyond the ability of the present staff to care for them properly. No additional personnel has been available, and all the necessary details have been attended to by the field force and the staff of the Washington office in addition to their regular duties. Proper administration of this work would require the exclusive attention of several new employees.

While the bureau has exacted the provision, in all agreements for the establishment of nurseries, that 50 per cent of the output may be claimed by the Government for filling its applications, there has been no need to insist upon strict compliance with this ruling to date. The number of fish taken from cooperative nurseries for distribution to other than local waters has been negligible, and the sponsors of the various projects have received almost 100 per cent benefit from the output. There has been a tendency to increase the number of nursery projects in a single locality unduly, the success of a pioneer project inducing the formation of new ones in the near

vicinity. This tends to defeat the purpose of the nursery plan, as it results in a very unequal distribution of fish. The present need is not for more nurseries in fields already provided for, but for nurseries in new fields. The furthering of the private rearing pools is becoming one of the important activities of the division of fish culture, and the movement is developing strongly in many of the States. The bureau can not issue general instructions for the guidance of those desiring to establish nursery pools in various parts of the country. Each proposed project must be considered on its merits and the plans adapted to local conditions rather than to an inflexible design. Personal inspection by an experienced fish-culturist should always precede actual initiation of work upon a nursery enterprise.

The experience of the past two or three years has shown that bass ponds of the proper type are exceedingly rare, and it is difficult to find suitable sites for them. There will be opportunity to construct 20 good trout pools for every satisfactory bass pond. In many sections the establishment of a first-class nursery for warm-water fish is virtually impossible except at inordinate expense. Consequently, the bureau has held that where facilities for bass rearing are suitable they should, by all means, be utilized; but that mere desire is not justification for initiation of work with this fish when natural advantages are lacking.

OUTPUT

The aggregate output of fish and eggs is the only criterion available at the present time for judging the efficiency of the bureau's fish-cultural activities. It is therefore gratifying to report that the distribution of 7,036,317,200 eggs, fry and fingerlings for 1928 brings the production above the high record of the previous year by about 550,000,000. Segregation of the various items making up the total shows a distribution of 261,634,200 fingerlings, representing a 37 per cent increase over last year's figures, as the bureau's response to the demand for larger fish. Strictly game species comprised only 2.7 per cent of the total output, although the bureau's work is largely viewed by the general public as being limited to the propagation of the latter species. The proportions of marine commercial species, commercial species of interior waters, and commercial anadromous forms in the total were relatively about the same as in previous years, being 8.2, 8.3, and 4.1 per cent, respectively, while the percentage of the commercial salmons of the Pacific coast was increased from 1.9 to 2.9.

Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1928

Species	Eggs	Fry	Fingerlings	Total
Paddlefish			33,000	33,000
Catfish			87,181,600	87,181,600
Buffalo fish	29,150,000	8,392,000	2,320,600	39,862,600
Carp	29,250,000	5,500,000	3,839,900	38,589,900
Shad		48,031,000		48,031,000
Glut herring		55,000,000		55,000,000
Whitefish	20,000	117,188,000		117,208,000

Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1928—Continued

Species	Eggs	Fry	Fingerlings	Total
Cisco	8,000,000	89,125,000		97,125,000
Chinook salmon	19,033,000	343,000	38,531,900	57,907,900
Chum salmon	3,000,000	20,669,000		23,669,000
Silver salmon	1,025,000	10,852,000	2,073,500	13,950,500
Sockeye salmon	4,410,000	13,562,000	19,101,600	37,073,600
Humpback salmon		2,387,000		2,387,000
Steelhead salmon	1,360,000	1,183,000	2,188,600	4,731,600
Atlantic salmon	350,000		1,202,400	1,552,400
Landlocked salmon	78,000		325,500	403,500
Rainbow trout	6,166,000	710,000	6,906,300	13,782,300
Black-spotted trout	7,156,000	175,000	7,214,500	14,545,500
Loch Leven trout	8,290,000	1,726,000	1,845,300	11,861,300
Lake trout	7,364,000	28,496,000	1,824,700	37,684,700
Brook trout	2,196,000	2,880,000	14,413,400	19,489,400
Grayling		725,000	100	725,100
Pike and pickerel	210,000		2,363,900	2,573,900
Mackerel		5,212,000		5,212,000
Crappie			23,482,500	23,482,500
Largemouth black bass		954,000	1,634,800	2,588,800
Smallmouth black bass		598,000	120,400	718,400
Rock bass			111,400	111,400
Warmouth bass			1,000	1,000
Sunfish			32,829,300	32,829,300
Pike perch	56,210,000	201,170,000		257,380,000
Yellow perch		175,825,000	1,569,200	177,394,200
Striped bass		7,231,000		7,231,000
White perch			2,400	2,400
White bass			10,200	10,200
Fresh-water drum			272,500	272,500
Cod	1,914,734,000	660,251,000		2,574,985,000
Haddock	143,885,000	118,658,000		262,543,000
Pollock		138,373,000		138,373,000
Winter flounder	11,357,000	2,806,223,000		2,817,580,000
Miscellaneous fishes			10,233,700	10,233,700
Total	2,253,244,000	4,521,439,000	261,634,200	7,036,317,200

EGG COLLECTIONS

In spite of the greater output of fish, there was a slight decline in the egg collections for the year. The total was 7,883,670,160, a recession of 67,841,170 from the figures of last year. This shortage is more than accounted for in the smaller number of flounder eggs—one of the marine fishes of lesser importance. This decline is partly offset by a more than 100 per cent increase in shad-egg collections and by substantial gains among the commercially important lake trout and pike perch. Collections of whitefish and cisco eggs in the Great Lakes again showed a decline, however, traceable in part to unfavorable weather conditions during the spawning season. An increase of almost 10,000,000 eggs was recorded by the resumption of striped-bass hatching operations in North Carolina. The total collections of cod, haddock, and winter-flounder eggs exceeded the figures of last year. The tabulation below gives the statistical details of the egg collections. It may be added that the only eggs purchased at the present time are those of the brook trout, and the number is negligible. Plans are being made for developments that will make it unnecessary to purchase any eggs in the near future.

Comparison of egg collections, fiscal years 1928 and 1927

Species	1928	1927	Species	1928	1927
Buffalo fish	10,200,000	3,000,000	Black-spotted trout	23,115,000	4,176,000
Carp	7,500,000	24,750,000	Loch Leven trout	15,767,800	15,426,000
Shad	51,473,000	23,104,000	Lake trout	85,911,340	73,241,290
Glut herring	223,444,000	5,160,000	Brook trout	18,509,290	20,762,290
Whitefish	198,709,500	219,023,000	Smelt		9,250,000
Cisco	172,822,500	243,870,000	Mackerel	6,237,000	
Chub		400,000	Pike perch	729,610,000	570,980,000
Chinook salmon	58,792,800	60,649,600	Yellow perch	184,890,000	221,595,000
Chum salmon	25,247,000	24,557,000	Striped bass	9,415,000	
Humpback salmon	2,625,000	4,212,000	Cod	2,373,459,000	1,427,912,000
Silver salmon	15,452,000	6,334,000	Haddock	331,417,000	423,637,000
Sockeye salmon	44,495,000	64,606,800	Pollock	213,867,000	1,048,534,000
Steelhead salmon	4,729,500	3,859,000	Winter flounder	3,054,153,000	3,434,777,000
Landlocked salmon	767,950	773,700			
Rainbow trout	21,060,480	16,921,650	Total	7,883,670,160	7,951,511,330

As an explanation of the sources from which the bulk of the eggs are derived, there is given below a list of the temporary collecting plants operated by the various stations. These are utilized merely for the collection and fertilization of eggs for immediate transfer to the hatcheries and are distinct from the auxiliary field stations, which may incubate as well as take the eggs. Upon the more intensive development of these collecting stations, in capacity or number, is based the very marked increase in output of the past two years.

Egg-collecting stations

Station	Period of operation	Species handled
Baker Lake, Wash.:		
Brinnon, Wash	Sept. 12–Sept. 28	Chum salmon (early run).
Do	Nov. 24–Jan. 10	Chum salmon (late run).
Boothbay Harbor, Me.:		
Boothbay Harbor, Me	Mar. 1–June 20	Cod and winter flounder.
Ebencook Harbor, Me	Mar. 1–Apr. 30	Winter flounder.
Johns Bay, Me	do	Do.
Linekins Bay, Me	do	Do.
Little River, Me	do	Do.
Mill Cove, Me	do	Do.
Pig Cove, Me	do	Do.
Townsend Gut, Me	do	Do.
West Harbor, Me	do	Do.
Cape Vincent, N. Y.:		
Amherst Island, Ontario	Oct. 25–Nov. 8	Lake trout.
Bowmanville, Ontario	Nov. 4–Nov. 15	Whitefish.
Brighton, Ontario	Nov. 2–Nov. 15	Do.
Charity Shoals, N. Y	Oct. 24–Nov. 14	Lake trout.
Chaumont Bay, N. Y	Nov. 12–Dec. 1	Whitefish and cisco.
Cobourg, Ontario	Nov. 4–Nov. 15	Whitefish.
Consecon, Ontario	Oct. 25–Nov. 24	Lake trout and cisco.
Fair Haven, N. Y	Nov. 22–Dec. 2	Cisco.
Gardenville, N. Y	Nov. 15–Nov. 23	Do.
Indian Point, Ontario	Oct. 25–Nov. 18	Lake trout and whitefish.
Pigeon Island, Ontario	Oct. 24–Nov. 10	Lake trout.
Port Hope, Ontario	Nov. 10–Nov. 18	Whitefish.
Simcoe Island, Ontario	Oct. 25–Nov. 16	Lake trout and whitefish.
Sodus Point, N. Y	Nov. 20–Nov. 27	Cisco.
Stoney Island, N. Y	Oct. 24–Nov. 4	Lake trout.
Clackamas, Oreg.:		
Lemhi River, Idaho	Aug. 14–Sept. 14	Chinook salmon.
Williams Lake, Idaho	Apr. 23–May 19	Rainbow trout.
Craig Brook, Me.:		
Craig Pond, Me	Oct. 20–Nov. 25	Brook trout.
Toddy Pond, Me	Oct. 20–Oct. 31	Landlocked salmon.
Duluth, Minn.:		
Au Train, Mich	Oct. 17–Nov. 3	Lake trout.
Baraga, Mich	do	Do.
Calumet Water Works, Mich	Oct. 17–Oct. 26	Do.
Copper Harbor, Mich	Oct. 1–Oct. 12	Do.
Grand Marais, Mich	Oct. 17–Nov. 6	Do.

Egg-collecting stations—Continued

Station	Period of operation	Species handled
Duluth, Minn.—Continued.		
Huron Island, Mich.	Oct. 16–Nov. 2	Lake trout.
Isle Royale ports, Mich.	Oct. 1–Nov. 13	Lake trout and whitefish.
Keystone, Mich.	Oct. 17–Oct. 27	Lake trout.
Little Girls Point, Mich.	Oct. 15–Oct. 31	Do.
Manitou Island, Mich.	Oct. 15–Oct. 23	Do.
Marquette, Mich.	Oct. 17–Nov. 5	Do.
Munising, Mich.	Oct. 17–Nov. 1	Do.
Portage Entry, Mich.	Oct. 18–Nov. 3	Do.
Portage Lake Canal, Mich.	Oct. 12–Nov. 1	Do.
Gloucester, Mass.:		
Boars Head, N. H.	Mar. 1–May 15	Cod.
Marblehead, Mass.	Feb. 1–Mar. 15	Do.
Plymouth, Mass.	Nov. 1–May 15	Cod and pollock.
Rockport, Mass.	do	Cod, pollock, and haddock.
Leadville, Colo.:		
Bolts Lake, Colo.	Apr. 30–May 17	Rainbow trout.
Engelbrecht Lakes, Colo.	Sept. 19–Nov. 25	Brook trout.
Hermosa Lake, Colo.	Nov. 18–Dec. 15	Do.
Hosselkus Lakes, Colo.	Apr. 30–July 1	Rainbow trout.
Mount Massive Club Lakes, Colo.	Oct. 19–Dec. 12	Brook trout.
Turquoise Lake, Colo.	Oct. 18–Dec. 3	Brook and Loch Leven trout.
Wurts Lakes, Colo.	Oct. 4–Dec. 3	Brook trout.
Nashua, N. H.: Lebanon, N. H.	Apr. 29–May15	Rainbow trout.
Northville, Mich.:		
Alcona, Mich.	Oct. 29	Lake trout.
Alpena, Mich.	Oct. 21–Dec. 3	Lake trout and whitefish.
Bay City, Mich.	Nov. 21	Whitefish.
Do.	Apr. 8–Apr. 30	Pike perch.
Black River, Mich.	Oct. 29–Nov. 1	Lake trout.
Cheboygan, Mich.	Oct. 14–Oct. 29	Do.
Epoufette, Mich.	Nov. 17–Nov. 25	Whitefish.
Greenbush, Mich.	Nov. 13–Nov. 16	Do.
Hammonds Bay, Mich.	Nov. 13	Do.
Harbor Beach, Mich.	Oct. 26–Nov. 14	Lake trout.
Middle Island, Mich.	Oct. 13–Nov. 5	Do.
Oscoda, Mich.	Oct. 28–Nov. 1	Do.
Presque Island, Mich.	Oct. 25–Oct. 27	Do.
Rockport, Mich.	Oct. 23–Nov. 26	Lake trout and whitefish.
Rogers City, Mich.	Oct. 29	Lake trout.
St. Ignace, Mich.	Oct. 26–Oct. 29	Do.
Put in Bay, Ohio:		
Catawba Island, Ohio	Nov. 9–Nov. 30	Whitefish.
Middle Bass, Ohio	Nov. 9–Nov. 27	Do.
North Bass, Ohio	do	Do.
Port Clinton, Ohio	Nov. 9–Dec. 2	Do.
Do.	Apr. 6–May 8	Pike perch and yellow perch.
Do.	June 7–June 25	Carp.
Toledo, Ohio	Nov. 10–Nov. 25	Whitefish.
Do.	Apr. 7–May 7	Pike perch.
St. Johnsbury, Vt.: Lake Dunmore, Vt.	Nov. 2–Nov. 12	Lake trout.
Saratoga, Wyo.:		
Big Creek Lakes, Colo.	Sept. 12–Nov. 10	Brook trout.
Lost, Sage, and Canon Creeks, Wyo.	Mar. 22–July 2	Rainbow trout.
Springville, Utah:		
Fish Lake, Utah	Nov. 3–Dec. 6	Brook trout.
Do.	Apr. 9–May 30	Rainbow trout.
Woods Hole, Mass.:		
Newport, R. I.	November	Cod.
Waquoit, Mass.	January to April	Winter flounder.

FISH-RESCUE WORK

The total of 145,176,900 fish handled in the rescue work of the 1928 season represents a noticeable increase over last year and a return to the conditions that prevailed in earlier years. The greater magnitude of the 1928 operations is due to the fact that water conditions on the upper Mississippi were such as to permit and necessitate widespread seining and to the fact that the disastrous floods on the lower Mississippi required much work in a field that ordinarily needs little attention. In the States of Arkansas, Mississippi, and Louisiana (covered by the bureau's Mammoth Spring (Ark.) and Tupelo (Miss.) stations) 25,981,900 fish were handled. Almost all

were returned to parental waters. The usual negligible proportion (less than 1 per cent) of the fish rescued in the upper Mississippi territory was distributed by car or messenger to other sections. The continual requests for carload shipments of rescued fish are a source of embarrassment in view of the fact that the present negligible diversion of fish from the Mississippi occasion considerable criticism from the States whose waters are being seined. Mindful of the fact that such diversions can not be continued indefinitely, the bureau is taking steps to propagate warm-water fishes on land under Federal jurisdiction in the Upper Mississippi Wild Life Refuge. Several sites were selected during the past year, and these will be put on a productive basis as fast as circumstances permit. A summary of the rescue work appears below.

Number and disposition of fish rescued, fiscal year 1928

Locality and species	Delivered to applicants	Restored to original waters	Total number of fish rescued
Homer, Minn.:			
Black bass	8,120	60,500	68,620
Buffalo fish		2,045	2,045
Carp		220,320	220,320
Catfish	13,600	5,219,500	5,233,100
Crappie	54,385	7,810,140	7,864,525
Fresh-water drum		10,495	10,495
Pike and pickerel		1,713,823	1,713,823
Sunfish	36,400	8,788,800	8,825,200
White bass		1,470	1,470
Yellow perch	6,370	1,453,675	1,460,045
Miscellaneous		2,478,968	2,478,968
Total	118,875	27,759,736	27,878,611
La Crosse, Wis.:			
Black bass	17,096	11,170	28,266
Buffalo fish		316,000	316,000
Carp		383,000	383,000
Catfish	8,700	5,901,300	5,910,000
Crappie	10,250	1,127,050	1,137,300
Fresh-water drum		1,000	1,000
Pike and pickerel		270,100	270,100
Sunfish	16,170	1,968,210	1,984,380
White bass		1,300	1,300
Yellow perch	3,750	41,145	44,895
Miscellaneous		1,413,800	1,413,800
Total	55,966	11,434,075	11,490,041
Lynxville, Wis.:			
Black bass	27,314	9,465	36,779
Buffalo fish		19,000	19,000
Carp		101,000	101,000
Catfish	38,731	19,025,300	19,064,031
Crappie	4,942	3,008,312	3,013,254
Pike and pickerel		216,800	216,800
Sunfish	41,435	2,226,005	2,267,440
Yellow perch	3,210	19,740	22,950
Miscellaneous		2,283,500	2,283,500
Total	115,632	26,909,122	27,024,754
Marquette, Iowa:			
Black bass	55,805	23,950	79,755
Buffalo fish		207,005	207,005
Carp		684,950	684,950
Catfish	33,825	35,119,175	35,153,000
Crappie	5,900	6,439,370	6,445,270
Fresh-water drum		400	400
Pike and pickerel		153,527	153,527
Rock bass	120		120
Sunfish	18,540	7,350,730	7,369,270
White bass		4,092	4,092
Yellow perch	3,250	36,625	39,875
Miscellaneous		90,000	90,000
Total	117,440	50,109,824	50,227,264

Number and disposition of fish rescued, fiscal year 1928—Continued

Locality and species	Delivered to applicants	Restored to original waters	Total number of fish rescued
Bellevue, Iowa:			
Black bass	17,115	7,675	24,790
Buffalo fish		585,900	585,900
Carp		646,400	646,400
Catfish	38,850	7,111,150	7,150,000
Crappie	17,115	416,955	434,070
Fresh-water drum		211	211
Pike and pickerel		6,712	6,712
Sunfish	44,755	277,620	322,375
White bass		832	832
Yellow perch	590	250	840
Miscellaneous		671,510	671,510
Total	118,425	9,725,215	9,843,640
Rock Island, Ill.:			
Black bass		3,625	3,625
Buffalo fish		45,945	45,945
Carp		133,650	133,650
Catfish		5,010,300	5,010,300
Crappie		3,010,900	3,010,900
Pike and pickerel		1,240	1,240
Sunfish		2,839,075	2,839,075
Miscellaneous		3,289,500	3,289,500
Total		14,334,235	14,334,235
Simmesport, La.:			
Black bass	440	463	903
Buffalo fish		682,500	682,500
Carp	115	928,185	928,300
Catfish		1,426,000	1,426,000
Crappie	430	538,070	538,500
Fresh-water drum		260,400	260,400
Paddlefish		32,975	32,975
Sunfish	9,625	492,325	501,950
White bass		430	430
Miscellaneous		6,400	6,400
Total	10,610	4,367,748	4,378,358
Friars Point, Miss.:			
Black bass	21,630	467,800	489,430
Buffalo fish		462,125	462,125
Carp		742,200	742,200
Catfish	100	2,212,455	2,212,555
Crappie	9,260	987,925	997,185
Pike and pickerel		1,700	1,700
Sunfish	57,540	8,012,550	8,070,090
White bass		2,075	2,075
Total	88,530	12,888,830	12,977,360
All stations:			
Buffalo fish		2,320,520	2,320,520
Carp	115	3,839,705	3,839,820
Catfish	113,806	81,025,180	81,158,986
Crappie	102,282	23,338,722	23,440,104
Fresh-water drum		272,506	272,506
Largemouth black bass	147,520	584,648	732,168
Paddlefish		32,975	32,975
Pike and pickerel		2,363,902	2,363,902
Rock bass	120		120
Sunfish	224,465	31,955,315	32,179,780
White bass		10,199	10,199
Yellow perch	17,170	1,551,435	1,568,605
Miscellaneous		10,233,678	10,233,678
Total	625,478	157,528,785	158,154,263
Summary, by stations:			
Homer, Minn	118,875	27,759,736	27,878,611
La Crosse, Wis	55,966	11,434,075	11,490,041
Lynxville, Wis	115,632	26,909,122	27,024,754
Marquette, Iowa	117,440	50,109,824	50,227,264
Bellevue, Iowa	118,425	9,725,215	9,843,640
Rock Island, Ill		14,334,235	14,334,235
Simmesport, La	10,610	4,367,748	4,378,358
Friars Point, Miss	88,530	12,888,830	12,977,360
Total	625,478	157,528,785	158,154,263

SHIPMENTS TO FOREIGN COUNTRIES

The bureau frequently receives requests from foreign governments for fish or eggs for acclimatization in their waters. Whenever it seems possible that our fishes may become established and eggs or fish are available the bureau endeavors to send an assignment sufficiently large to become the nucleus of a breeding stock. The top minnow, Gambusia, has been in great demand for mosquito-control work in foreign countries. Shipments of this fish to Italy and Bermuda were reported to have arrived in good condition. Following is a list of shipments made during the past year in response to formal diplomatic requests.

Shipments of fish and fish eggs to foreign countries, fiscal year 1928

Country and species	Number of eggs	Number of fish
Costa Rica: Rainbow trout	25,000	
Cuba: Largemouth black bass		500
Ecuador: Steelhead salmon	50,000	
Germany: Rainbow trout	50,000	
Peru: Rainbow trout	50,000	
Switzerland: Rainbow trout	50,000	
Total	225,000	500

PRODUCTION AT STATIONS AND SUBSTATIONS

The output of fish and eggs cited above was derived from 38 main stations and 35 substations or auxiliaries. Many of the latter are operated during part of the year only with a force detailed from one of the main stations. A few of the substations, however, constitute plants almost as large as the headquarters station and are listed as auxiliaries for administrative reasons only. The roster of the bureau's stations shows that the location of the Federal hatcheries is such that many sections can not be served except at heavy expense for the transportation of fish. The nature and extent of operations at these agencies is indicated in the following table:

Stations and substations operated and output of each, fiscal year 1928

[Asterisk (*) denotes transfer of eggs. See table, p. 358]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Afognak, Alaska: Sockeye salmon		225,000	3,450,000	3,675,000
Baird, Calif.: Chinook salmon			1,642,000	1,642,000
Battle Creek, Calif.: Chinook salmon	(*)		1,811,200	1,811,200
Mill Creek, Calif.: Chinook salmon	* 954,000		2,152,500	3,106,500
Baker Lake, Wash.:				
Silver salmon		3,225,000		3,225,000
Sockeye salmon	(*)	1,291,000	1,594,000	2,885,000
Birdsview, Wash.—				
Carp			10	10
Chinook salmon			1,120,650	1,120,650
Humpback salmon		1,085,000		1,085,000
Silver salmon	100,000	885,000	573,400	1,558,400
Sockeye salmon			158,000	158,000
Steelhead salmon	* 290,000	613,000	972,000	1,875,000

Stations and substations operated and output of each, fiscal year 1928—Contd.

[Asterisk (*) denotes transfer of eggs. See table, p. 358]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Baker Lake, Wash.—Continued.				
Duckabush, Wash.—				
Chinook salmon			537,800	537,800
Chum salmon	1,500,000	13,140,000		14,640,000
Humpback salmon		1,160,000		1,160,000
Silver salmon		274,800	79,700	354,500
Quilcene, Wash.—				
Chinook salmon		50,000	484,500	534,500
Chum salmon	1,500,000	7,529,000		9,029,000
Humpback salmon		81,000		81,000
Silver salmon		2,336,000		2,336,000
Steelhead salmon			190,500	190,500
Sultan, Wash.—				
Chinook salmon		292,500	40,700	333,200
Humpback salmon		61,000		61,000
Silver salmon		3,432,400	50,900	3,483,300
Steelhead salmon		474,500	59,500	534,000
Berkshire trout hatchery, Mass.:				
Brook trout			313,620	313,620
Lake trout			8,200	8,200
Rainbow trout			17,830	17,830
Boothbay Harbor, Me.:				
Cod	1,689,330,000			1,689,330,000
Winter flounder		2,022,829,000		2,022,829,000
Bozeman, Mont.:				
Black-spotted trout			1,217,610	1,217,610
Brook trout			652,150	652,150
Grayling			40	40
Loch Leven trout	*2,840,000		11,010	2,851,010
Rainbow trout			725,400	725,400
Glacier Park, Mont.—				
Black-spotted trout			944,000	944,000
Grayling		725,000		725,000
Rainbow trout			476,000	476,000
Meadow Creek, Mont.—				
Black-spotted trout	160,000	175,000	840,000	1,175,000
Loch Leven trout	*5,450,000	1,726,300	804,000	7,980,300
Rainbow trout	*526,000		698,000	1,224,000
Cape Vincent, N. Y.:				
Brook trout		217,500	368,430	585,930
Cisco	*8,000,000	86,950,000		94,950,000
Lake trout	500,000	3,064,000	49,600	3,613,600
Loch Leven trout			12,950	12,950
Rainbow trout			43,700	43,700
Whitefish		16,040,000		16,040,000
Yellow perch		2,000,000		2,000,000
Swanton, Vt.—				
Pike perch	56,210,000	40,500,000		96,710,000
Yellow perch		21,100,000		21,100,000
Central Station, Washington, D. C.:				
Largemouth black bass			60	60
Brook trout			102,000	102,000
Catfish			200	200
Chinook salmon			7,000	7,000
Cisco		1,300,000		1,300,000
Crappie			250	250
Rainbow trout			56,500	56,500
Rock bass			30	30
Smallmouth black bass		25,000	20	25,020
Sunfish			150	150
Bryans Point, Md.—				
Shad		40,981,500		40,981,500
Yellow perch		138,320,000		138,320,000
Lakeland, Md.—				
Largemouth black bass			30,360	30,360
Crappie			17,730	17,730
Sunfish			19,620	19,620
Clackamas, Oreg.:				
Brook trout	*464,000		267,000	731,000
Chinook salmon			2,610,000	2,610,000
Rainbow trout			100,000	100,000
Steelhead salmon			46,000	46,000
Applegate, Oreg.—				
Silver salmon	925,000		1,369,500	2,294,500
Steelhead salmon	*1,070,000		797,700	1,867,700
Big White Salmon, Wash.—				
Brook trout			175,000	175,000
Chinook salmon	*8,523,000		7,959,000	16,482,000
Rainbow trout			72,000	72,000
Steelhead salmon		95,000		95,000

Stations and substations operated and output of each, fiscal year 1928—Contd.

[Asterisk (*) denotes transfer of eggs. See table, p. 358]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Clackamas, Oreg.—Continued.				
Little White Salmon, Wash.—				
Brook trout			181,000	181,000
Chinook salmon	*9,541,000		11,093,000	20,634,000
Sockeye salmon			26,500	26,500
Steelhead salmon			86,000	86,000
Rogue River, Oreg.—				
Chinook salmon			1,499,000	1,499,000
Sockeye salmon			71,000	71,000
Salmon, Idaho: Chinook salmon			5,043,000	5,043,000
Snake River, Idaho: Chinook salmon			2,306,500	2,306,500
Cold Springs, Ga.:				
Largemouth black bass		163,000	131,950	294,950
Catfish			7,040	7,040
Sunfish			102,920	102,920
Craig Brook, Me.:				
Atlantic salmon	350,000		1,202,400	1,552,400
Brook trout	(*)	60,000	1,439,030	1,499,030
Landlocked salmon	*50,000		68,930	118,930
Smallmouth black bass			160	160
White perch			2,400	2,400
Grand Lake Stream, Me.—				
Brook trout		218,500	44,270	262,770
Landlocked salmon	(*)		242,200	242,200
Green Lake, Me.—				
Landlocked salmon	28,000			28,000
Smallmouth black bass			160	160
Duluth, Minn.:				
Brook trout			208,000	208,000
Cisco		875,000		875,000
Lake trout	*3,785,700	12,855,000	1,515,000	18,155,700
Pike perch		10,670,000		10,670,000
Rainbow trout			15,750	15,750
Whitefish		548,000		548,000
Edenton, N. C.:				
Largemouth black bass		12,000	35,140	47,140
Crappie			600	600
Glut herring		55,000,000		55,000,000
Shad		7,050,000		7,050,000
Sunfish			6,400	6,400
Yellow perch		10,760,000	1,280	10,761,280
Weldon, N. C.: Striped bass		7,230,800		7,230,800
Erwin, Tenn.:				
Largemouth black bass		20,000	21,880	41,880
Brook trout			303,050	303,050
Rainbow trout			480,800	480,800
Rock bass			27,450	27,450
Steelhead salmon			27,740	27,740
Sunfish			14,190	14,190
Fairport, Iowa:				
Largemouth black bass		1,620	24,370	25,990
Crappie			5,090	5,090
Smallmouth black bass			1,780	1,780
Sunfish			51,500	51,500
Gloucester, Mass.:				
Cod	221,753,000	481,252,000		703,005,000
Haddock	143,885,000	118,658,000		262,543,000
Pollock		138,373,000		138,373,000
Winter flounder		199,287,000		199,287,000
Homer, Minn.:				
Largemouth black bass			68,620	68,620
Buffalo fish			2,040	2,040
Carp			220,320	220,320
Catfish			5,233,100	5,233,100
Crappie			7,864,530	7,864,530
Fresh-water drum			10,490	10,490
Pike and pickerel			1,713,820	1,713,820
Sunfish			8,825,200	8,825,200
White bass			1,470	1,470
Yellow perch			1,460,050	1,460,050
Miscellaneous			2,478,970	2,478,970
La Crosse, Wis.:				
Largemouth black bass			28,270	28,270
Brook trout			755,020	755,020
Buffalo fish	15,300,000	8,392,000	316,000	24,008,000
Carp	16,750,000		383,000	17,133,000
Catfish			5,910,000	5,910,000
Crappie			1,137,300	1,137,300
Fresh-water drum			1,000	1,000
Loch Leven trout			135,850	135,850

Stations and substations operated and output of each, fiscal year 1928—Contd.

[Asterisk (*) denotes transfer of eggs. See table, p. 358]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
La Crosse, Wis.—Continued.				
Pike and pickerel	210,000		270,100	480,100
Rainbow trout			263,700	263,700
Sunfish			1,984,380	1,984,380
White bass			1,300	1,300
Yellow perch			44,900	44,900
Miscellaneous			1,413,800	1,413,800
Bellevue, Iowa—				
Largemouth black bass			24,790	24,790
Buffalo fish	13,850,000		585,900	14,435,900
Carp	12,500,000		646,400	13,146,400
Catfish			7,150,000	7,150,000
Crappie			434,070	434,070
Fresh-water drum			210	210
Pike and pickerel			6,710	6,710
Sunfish			322,380	322,380
White bass			830	830
Yellow perch			840	840
Miscellaneous			671,510	671,510
Lynxville, Wis.—				
Largemouth black bass			37,240	37,240
Buffalo fish			19,000	19,000
Carp			101,000	101,000
Catfish			25,064,030	25,064,030
Crappie			3,013,250	3,013,250
Pike and pickerel			216,800	216,800
Sunfish			2,267,440	2,267,440
Yellow perch			22,950	22,950
Miscellaneous			2,283,500	2,283,500
Marquette, Iowa—				
Largemouth black bass			79,760	79,760
Buffalo fish			207,000	207,000
Carp			684,950	684,950
Catfish			35,153,000	35,153,000
Crappie			6,445,270	6,445,270
Fresh-water drum			400	400
Pike and pickerel			153,530	153,530
Rock bass			120	120
Sunfish			7,369,270	7,369,270
White bass			4,090	4,090
Yellow perch			39,870	39,870
Miscellaneous			90,000	90,000
Rock Island, Ill.—				
Largemouth black bass			3,630	3,630
Buffalo fish			45,940	45,940
Carp			133,650	133,650
Catfish			5,010,300	5,010,300
Crappie			3,010,900	3,010,900
Pike and pickerel			1,240	1,240
Sunfish			2,839,080	2,839,080
Miscellaneous			3,289,500	3,289,500
Simmesport, La.—				
Largemouth black bass			900	900
Buffalo fish			682,500	682,500
Carp			928,300	928,300
Catfish			1,426,000	1,426,000
Crappie			538,500	538,500
Fresh-water drum			260,400	260,400
Paddlefish			32,970	32,970
Sunfish			501,950	501,950
White bass			430	430
Miscellaneous			6,400	6,400
Yellowstone, Wyo.: Black-spotted trout	*6,996,000		3,833,000	10,829,000
Leadville, Colo.:				
Black-spotted trout			188,800	188,800
Brook trout	*600,000		4,218,600	4,818,600
Lake trout			83,500	83,500
Loch Leven trout			184,000	184,000
Rainbow trout	200,000		481,000	681,000
Louisville, Ky.:				
Largemouth black bass			2,800	2,800
Catfish			100	100
Rock bass			3,250	3,250
Smallmouth black bass		510,000	4,630	514,630
Mammoth Spring, Ark.:				
Largemouth black bass			70,580	70,580
Catfish			600	600
Rock bass			46,500	46,500

Stations and substations operated and output of each, fiscal year 1928—Contd.

[Asterisk (*) denotes transfer of eggs. See table, p 358]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Mammoth Spring, Ark.—Continued.				
Smallmouth black bass			68,000	68,000
Sunfish			35,230	35,230
Manchester, Iowa:				
Brook trout			401,000	401,000
Rainbow trout	*358,000		98,050	456,050
Nashua, N. H.:				
Brook trout			398,270	398,270
Catfish			370	370
Landlocked salmon			12,770	12,770
Rainbow trout		10,000	63,330	73,330
Smallmouth black bass		15,500		15,500
Neosho, Mo.:				
Largemouth black bass			11,280	11,280
Catfish			900	900
Crappie			2,510	2,510
Rainbow trout	*639,000		274,100	913,100
Rock bass			7,330	7,330
Sunfish			13,170	13,170
Yellow perch			180	180
Bourbon, Mo.: Rainbow trout	*1,750,000		29,500	1,779,500
Langdon, Kans.:				
Largemouth black bass			45,750	45,750
Catfish			9,000	9,000
Crappie			12,900	12,900
Rock bass			180	180
Sunfish			26,930	26,930
Northville, Mich.:				
Brook trout			699,300	699,300
Lake trout	600,000			600,000
Rainbow trout			264,900	264,900
Smallmouth black bass		39,000	44,600	83,600
Alpena, Mich.:				
Lake trout	*2,478,000	2,554,000	168,000	5,200,000
Rainbow trout			4,000	4,000
Whitefish	20,000	18,500,000		18,520,000
Charlevoix, Mich.:				
Lake trout		10,000,000		10,000,000
Whitefish		19,700,000		19,700,000
Orangeburg, S. C.:				
Largemouth black bass		90,200	69,030	159,230
Catfish			660	660
Crappie			300	300
Sunfish			27,170	27,170
Warmouth bass			650	650
Put in Bay, Ohio:				
Carp		5,500,000		5,500,000
Pike perch		150,000,000		150,000,000
Smallmouth black bass			370	370
Whitefish		62,400,000		62,400,000
Yellow perch		3,645,000		3,645,000
Quinault, Wash.:				
Brook trout	100,000	104,500		204,500
Chinook salmon	* 15,000		225,070	240,070
Silver salmon	(*)	699,000		699,000
Sockeye salmon	* 4,410,000	12,046,000	835,100	17,291,100
St. Johnsbury, Vt.:				
Brook trout		1,854,240	1,270	1,855,510
Lake trout		23,290	2,360	25,650
Landlocked salmon			1,610	1,610
Loch Leven trout			2,500	2,500
Holden, Vt.: Brook trout			29,750	29,750
York Pond, N. H.: Brook trout	* 25,000	125,000	5,610	155,610
San Marcos, Tex.:				
Largemouth black bass			246,350	246,350
Catfish			3,440	3,440
Crappie			5,430	5,430
Rock bass			1,240	1,240
Sunfish			98,680	98,680
New Braunfels, Tex.:				
Largemouth black bass			11,350	11,350
Sunfish			18,300	18,300
Saratoga, Wyo.:				
Black-spotted trout			191,000	191,000
Brook trout		300,000	561,000	861,000
Loch Leven trout			141,050	141,050
Rainbow trout	438,000	700,000	351,000	1,489,000
Lost Creek, Wyo.: Rainbow trout	* 1,001,000			1,001,000

Stations and substations operated and output of each, fiscal year 1928—Conta.

[Asterisk (*) denotes transfer of eggs. See table below]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Spearfish, S. Dak.:				
Brook trout			1,067,770	1,067,770
Loch Leven trout			96,700	96,700
Rainbow trout			278,050	278,050
Steelhead salmon			9,300	9,300
Springville, Utah:				
Brook trout	* 1,007,000		134,000	1,141,000
Rainbow trout	129,000		978,460	1,107,460
Tupelo, Miss.:				
Largemouth black bass		583,500	164,790	748,290
Catfish			210	210
Crappie			600	600
Sunfish			237,300	237,300
Warmouth bass			320	320
Friar Point, Miss.—				
Largemouth black bass			489,430	489,430
Buffalo fish			462,130	462,130
Carp			742,200	742,200
Catfish			2,212,550	2,212,550
Crappie			997,190	997,190
Pike and pickerel			1,700	1,700
Sunfish			8,070,090	8,070,090
White bass			2,070	2,070
White Sulphur Springs, W. Va.:				
Largemouth black bass			32,070	32,070
Brook trout			1,907,730	1,907,730
Loch Leven trout			461,250	461,250
Rainbow trout	[1] 1,130,000		551,230	1,681,230
Rock bass			7,450	7,450
Woods Hole, Mass.:				
Cod	3,651,000	178,999,000		182,650,000
Mackerel		5,212,000		5,212,000
Winter flounder	11,357,000	584,107,000		595,464,000
Wytheville, Va.:				
Largemouth black bass		83,250	5,900	89,150
Brook trout			156,980	156,980
Catfish			70	70
Rainbow trout			600,700	600,700
Rock bass			17,900	17,900
Smallmouth black bass		8,000	850	8,850
Sunfish			110	110
Yes Bay, Alaska:				
Brook trout			54,760	54,760
Sockeye salmon			12,967,000	12,967,000

TRANSFER OF EGGS BETWEEN STATIONS

The following table lists the species and numbers of eggs transferred between stations. The object of such transfers is to effect the widest possible distribution of the various species at a minimum cost and to relieve the pressure on those stations that take eggs in excess of their capacity to develop.

Transfer of eggs between stations, fiscal year 1928

Species	Number of eggs	From—	To—
Black-spotted trout	256,000	Yellowstone Park, Wyo	Leadville, Colo.
	200,000	do	Saratoga, Wyo.
Brook trout	254,000	Clackamas, Oreg	Big White Salmon, Wash.
	206,000	do	Little White Salmon, Wash.
	100,000	Craig Brook, Me	Grand Lake Stream, Me.
	100,000	Leadville, Colo	Bozeman, Mont.
	300,000	do	Saratoga, Wyo.
	300,000	York Pond, N. H	Nashua, N. H.
	100,000	do	Craig Brook, Me.
	490,000	Springville, Utah	Saratoga, Wyo.

Transfer of eggs between stations, fiscal year 1928—Continued

Species	Number of eggs	From—	To—
Chinook salmon	2,050,000	Big White Salmon, Wash.	Clackamas, Oreg.
	1,161,000	Little White Salmon, Wash.	Birdsview, Wash.
	1,081,000	do	Quilcene, Wash.
	3,000,000	do	Salmon, Idaho.
	12,000	Quinault, Wash.	Central Station, Washington, D.C.
	378,000	Battle Creek, Calif.	Baird, Calif.
	252,000	Mill Creek, Calif.	Do.
Cisco	1,360,000	Cape Vincent, N. Y.	Central Station, Washington, D.C.
Lake trout	219,000	Alpena, Mich.	Charlevoix, Mich.
	3,528,000	Duluth, Minn.	Do.
	50,000	do	Leadville, Colo.
Landlocked salmon	15,000	Craig Brook, Me.	St. Johnsbury, Vt.
	50,000	Grand Lake Stream, Me.	Craig Brook, Me.
Loch Leven trout	200,000	Bozeman, Mont.	White Sulphur Springs, W. Va.
	350,000	Meadow, Mont.	La Crosse, Wis.
	300,000	do	Bozeman, Mont.
Rainbow trout	20,000	do	Holden, Vt.
	50,000	do	Cape Vincent, N. Y.
	125,000	do	Glacier Park, Mont.
	25,000	White Sulphur Springs, W. Va.	Central Station, Washington, D.C.
	134,000	Manchester, Iowa	La Crosse, Wis.
	112,000	do	Northville, Mich.
	320,000	Neosho, Mo.	Do.
	113,000	do	La Crosse, Wis.
	87,000	Bourbon, Mo.	Do.
	478,000	Lost Creek, Wyo.	Saratoga, Wyo.
	26,000	do	San Marcus, Tex.
	100,000	do	Neosho, Mo.
Silver salmon	1,017,000	Quinault, Wash.	Puget Sound Stations, Wash.
	84,000	do	Clackamas, Oreg.
Sockeye salmon	50,000	do	Rogue River, Oreg.
	753,000	do	Birdsview, Wash.
	100,000	Baker Lake, Wash.	Do.
Steelhead salmon	50,000	Applegate, Oreg.	Clackamas, Oreg
	25,000	Birdsview, Wash.	Charlevoix, Mich.

GENERAL FISH-CULTURAL NOTES

NEW STATIONS

No new stations were operated during the year. However, a new substation at Fort Worth, Tex., auxiliary to the San Marcos station, has been virtually completed in respect to pond and water-supply construction. It is situated on property donated by the city. The ponds were completed too late to be used this season, but they will be on a productive basis in 1929. There are five ponds with a total water area of 17.59 acres. The station will be used largely for the propagation of bass and crappie. The work was carried on under a special appropriation of $18,000.

At the close of the year work had just been started on a combination trout and pond station at Crawford, Nebr. This will be operated as an auxiliary to the Spearfish (S. Dak.) station. It is to be built on park property donated by the city of Crawford, and work will also be conducted on Federal land belonging to the Fort Robinson Military Reservation. Trout will be propagated chiefly, but the station will serve as headquarters for directing cooperative rearing of warm-water fishes in the surrounding territory. An appropriation of $35,000 was made available July 1, 1927, and has been continued for the coming year.

At the close of the year the bureau acquired title to a large tract of land near Valdosta, Ga., on which it will build a hatchery to be

subsidiary to the Warm Springs (Ga.) station. Eventually this will be one of the largest pond stations in the country. A large lake basin can be flooded to give over 200 acres of water area. Plans are being made for the immediate development of the project.

During the year negotiations were under way for the acquisition of property by gift at Creede, Colo., for a trout station and for the purchase of land near Reagon, Okla., for a pond station. The former will be under the direction of the Leadville (Colo.) station and the latter will be an auxiliary of the Neosho (Mo.) station. As soon as title to these tracts is secured, construction will begin. Appropriations of $30,000 and $35,000, respectively, are available for the work.

The close of the year also marked the termination of shad-hatching operations on the Potomac River at Bryans Point, Md. The hatchery

FIGURE 2.—Site of a new fish hatchery at Valdosta, Ga.

is being transferred to a new site on Government-owned land in the Fort Humphreys (Va.) reservation, a short distance down the river, where new buildings are being erected. A new location will be more advantageous with respect to the collection of eggs.

Fish-cultural facilities in the Yellowstone Park are being augmented by the construction of rearing pools at Mammoth Springs.

CLAM HEADS AS FISH FOOD

The feeding of dried clam heads and clam meal to trout has virtually passed the experimental stage, and this material is being used regularly at several of the stations. The superintendent of the St. Johnsbury (Vt.) station has placed an order for several tons of it. It is a by-product, is relatively inexpensive, and appears to be valuable as an article of diet, especially for larger fish. The chief drawback at present is the fact that the supply is limited.

SPINY LOBSTERS

At the request of the Florida shellfish commissioner, an employee of the Boothbay Harbor (Me.) station was detailed to Florida to initiate artificial propagation of the spiny lobster, *Panulirus argus*. The work was conducted at Key West with equipment furnished by the State, and several million eggs were hatched. The State of Florida defrayed all the expenses of the undertaking. This is the first record of the successful propagation of this shellfish on a large scale.

HESEN FRY TRAP

The fry-collecting device developed at the Fairport (Iowa) biological station in connection with experimental pond-cultural work has been utilized at other stations. The basic principle of this apparatus is the same as that of the ordinary commercial pound net or salmon trap. A leader to the shore diverts the migrating fry into two "hearts," from whence they pass, by means of a funnel, into an inclosure that retains them. Being continuous in operation, the trap will catch all of the fry in a pond within a short time. Several of the pond stations have tested this trap and have found it to be very useful.

PENNING LAKE TROUT

The superintendent of the Cape Vincent (N. Y.) station reported a collection of lake-trout eggs virtually twice as large as that taken the previous year and credits the increase to the fact that a larger number of fish had been penned. The quality of the eggs was superior to the average secured by commercial fishermen.

COMMERCIAL FISHES

The original purpose of the Bureau of Fisheries was to propagate the food fishes, and in accordance with this design the bulk of the output of the fish-cultural stations consists of species of commercial value. During the past year 97.3 per cent of the total output was composed of species that are not classed as game fish. Emphasis is placed upon the work with the strictly marine forms, such as cod, pollock, and haddock, and upon the anadromous fishes, particularly the shad and herring and to some extent the Pacific salmons. This constitutes a recovery of a by-product and replaces a resource that otherwise would be lost. All of these forms are caught for market, and in many cases the eggs would constitute a total loss were it not for the bureau's spawn takers and hatchery men. Mackerel and striped-bass eggs were incubated during the past year, these operations having been resumed after a cessation of several years.

PACIFIC SALMONS

The periodicity of the runs of the five species of salmon is responsible for yearly fluctuations in output. Consequently there were recessions in the output of certain varieties, such as the sockeye salmon, but increases in the production of other varieties permitted

a total output slightly greater than that of last year. The various stations and substations are situated on the more important salmon streams from California to Alaska.

Afognak (Alaska) Station

(Frank L. Snipes, Superintendent)

The chief improvement at this station was the conversion of a storeroom into an office and the addition of three rooms to one of the fish-culturist cottages. The escapement of sockeye salmon into Letnik Lake was very small. Of the approximately 5,000 fish that entered the lake, 1,679 females produced slightly more than 4,000,000 eggs. A satisfactory number of these hatched, and the majority of the young fish were liberated as fingerlings in June. During the spawning season the adult fish were uniformly smaller than in past years, but apparently this did not affect the virility of their eggs. Persistent seining in Letnik Lake for the past three years has virtually ridded it of the predatory Dolly Varden trout. There was a satisfactory downstream migration of yearling sockeyes during May and June in 1928.

Yes Bay (Alaska) Station

(A. T. Looff, Superintendent)

A considerable amount of repairing and replacement has been necessary to keep the station in first-class condition. The entire water-supply line, including penstock and flume, was recaulked and the trestle repaired. Material has been obtained preparatory to rebuilding the penstock and flume. Shortage of water during the winter necessitated the construction of a temporary brush dam in the river in order to divert water to the intake. An entirely new foundation was built under the woodshed. The floor in the boiler room was renewed. Bad piles in the foundation of the boathouse were replaced, and the metal roof on the ice house was replaced by one of shingles. Considerable painting was done also. The reconstruction of the tramway to the landing was completed, and an addition was made to the tramway used for hauling wood. A vat in which nets will be treated was built. The launch *Puffin*, which had been out of use, was overhauled and has given good service. All other boats were thoroughly overhauled and repaired where necessary.

The year opened with over 10,000,000 sockeye fingerlings on hand. These were planted during July and August. Collecting operations yielded a total of slightly over 20,000,000 sockeye-salmon eggs. Water conditions were good, and it is believed that eggs were secured from virtually every salmon that entered the lake. The hatch was satisfactory, and at the close of the year over 16,000,000 fingerlings were retained in the ponds for feeding. The station also incubated a number of brook-trout eggs, the fry of which were distributed in southeastern Alaska waters. A number of predatory trout were destroyed by seining.

Baker Lake (Wash.) Station and Substations

(Joseph Kemmerich, Superintendent)

Favorable weather conditions prevailed in this field during the various spawning seasons, and the aggregate of the collections of eggs at all points covered exceeded that of the past two years. This increase was effected in spite of the fact that the run of sockeye salmon to Baker Lake has been negligible since the erection of the power dam at Concrete. The superintendent has given considerable thought to the establishment of a run of salmon in streams that are now poorly stocked. Ten streams and the lakes that feed some of them were inspected at various times during the year. In some of the waters there seemed to be little prospect of establishing a run of fish, but in others it was concluded to make systematic plants of fingerlings until favorable results are achieved or the futility of such attempts becomes evident. A very satisfactory run of chinook and humpback salmon ascended Puget Sound streams during the fall of 1927, and it is thought that these

species are increasing in numbers. The fish ladder at the Concrete dam in Baker River was observed carefully and, as had been noted previously, sockeye salmon again found difficulty in making the ascent. Certain changes were made in the racks, which permitted a small number to reach the tramcar for transfer over the dam. However, in the latter part of the season it was found necessary to collect the fish from the lower part of the lake by hand and carry them to the tramcar. A study was made of the effect of the dam on downstream migrants, but no definite conclusions were reached. It appears that some losses occurred, but the extent of these was indeterminate.

Baker Lake (Wash.) station.—Only minor repairs, such as repainting roofs of the station buildings, were made. A bridge over Thunder Creek Canyon, on the station trail, collapsed in August, and it was necessary to construct a new bridge in cooperation with the Forest Service. In the course of the 1927 run of sockeye salmon in Baker River 1,597 brood fish were secured. These were retained for ripening, and 1,810,000 eggs were obtained from them. The fry were fed, and a large number were being carried when the fiscal year closed. At the opening of the year 422,400 sockeye fingerlings from the previous year's hatch were on hand and were liberated shortly afterwards. A fair run of silver salmon reached the trap in Baker Lake, and nearly 3,500,000 eggs were taken. These were incubated at the Baker Lake station instead of being shipped, as in past years, to Birdsview, and the fry were liberated in Baker River.

Birdsview (Wash.) substation.—Minor repairs to the water-supply conduit and the station buildings were made from time to time. The old flume water supply was replaced by a wooden pipe line in July and August. During unusually high water in January a flood in Grandy Creek washed out the water-supply intake dam and headgate, necessitating pumping operations for the next few days. As soon as the water receded sufficiently, a temporary intake was constructed. A permanent dam will be installed within a short time. The water-supply line to the residence was replaced by a pipe of larger dimensions. Considerable trouble was experienced from the deposition of gravel in the creek channel through the station grounds and above the trap. The washing away of the creek banks during the high water in January also necessitated the construction of a temporary jetty in order to protect the pipe line.

This station handled sockeye, chinook, humpback, silver, and steelhead salmon during the year, as well as the eastern brook trout. Cutthroat-trout eggs to the number of 185,000 were incubated for the Skagit County Game Commission. Some trouble was experienced with fungus on trout. Feeding experiments were being conducted at the close of the year with the view of determining the most satisfactory food for replacing the expensive beef liver. The run of chinook salmon in the Skagit River was below normal. All sockeye eggs handled were transferred from other stations. The collection of humpback-salmon eggs was the largest since 1915. A temporary wire trap was installed in Phinney Creek, and a very satisfactory number of eggs of this species was collected. The small collection of chinook eggs was augmented later by a large shipment transferred from the Little White Salmon station. In addition to a short run of silver salmon, the above-mentioned flood put the trap out of commission, making it impossible to secure all the fish that ascended Grandy Creek, and less than 1,000,000 eggs of this species were taken. Shipments from other stations permitted the liberation of 885,000 advanced fry and over 500,000 fingerlings of various sizes; 12,000 fingerlings were on hand at the close of the year. Four hundred and thirty-four thousand fingerling steelheads were liberated in July and August. The run of steelheads in the spring of 1928 gave a collection of eggs exceeding any since 1918. The fish entered the creek during the flood in January, and it is possible that a few hundred thousand eggs were lost, due to the fact that the trap could not be operated until February. Many of the fish were still in the green state, making it necessary to pen them until they ripened, and some injuries resulted as well as considerable fungus. A rather high percentage of eggs proved to be infertile, probably due to the long time the fish were held in pens. A number of shipments of steelhead eggs were made, including 40,000 to Hawaii and 50,000 to Ecuador. While 100,000 brook-trout eggs were hatched with considerable success, a heavy mortality took place among the fingerlings. A shipment of 87 fancy Japanese goldfish, donated by the Japanese Government, was received, and the fish are being retained at the station.

Duckabush (Wash.) substation.—A fish-food house with a concrete floor was constructed, and repairs to other buildings were made. The old permanent trap in Duckabush River was torn out because it had not been properly constructed and had become dilapidated. It will be replaced by a new trap. A temporary rack and trap were built in the Duckabush River during July and August for intercepting the runs of humpback and chum salmon.

Extensive operations with the chum salmon were carried on at this station and at the Quilcene station. After 8,778,000 eggs had been collected, fishing operations were discontinued, due to the fact that the water supply available was limited. Eggs taken at the temporary trap between September 27 and October 13 were sent to the Quilcene station, and operations were terminated on that date. Most of the fish hatched were liberated as advanced fry. The late run of chum salmon in the Duckabush River was of little consequence, but this run of fish yielded a capacity collection of eggs at the Walcott Slough trap at Brinnon. The Duckabush station received 6,776,000 eggs from this source. These were transferred to the hatchery in the milt in cans. A collection of 1,279,000 humpback-salmon eggs, made while the chum-salmon eggs were being collected, represents the largest take of eggs of that species for a number of years. The resulting fish were planted in the fry stage in the Duckabush, Lyre, and Docewallops Rivers. The only silver-salmon eggs handled were 358,800 received from the Quinault station. The product, in the advanced fry and fingerling stages, was deposited in the Duckabush River. The planting of chinook-salmon fingerlings in the Duckabush River was carried on with the object of establishing a run of this species in that river.

Lake Crescent (Wash.) substation.—With the object of establishing a run of sockeye salmon in the Lyre River, the bureau has continued to rear large numbers of fingerlings of that species at the Lake Crescent hatchery, operated by the State of Washington. From 828,000 eggs received from the Quinault station, 826,000 fry were obtained and placed in two large rearing ponds for feeding. They were fed from April 20 to June 16 and then liberated in Lake Crescent.

Quilcene (Wash.) substation.—A new permanent trap was constructed in the Little Quilcene River, replacing an old and dilapidated affair. Temporary racks and pens also were built in August in time to catch the run of chum salmon. It was necessary to construct a jetty about 100 feet long in the Quilcene River to prevent washing away of the bank.

Chum-salmon egg collections were made in the Quilcene River and also in the Duckabush River after the Duckabush station had become filled. At the Walcott Slough trap, operated by the Duckabush and Quilcene stations, 5,391,000 eggs were collected from the late-run chum salmon, and a smaller number was obtained from the Little Quilcene River. A total of 7,577,000 fry resulted from all collections of this species. Further plants of chinook-salmon fingerlings were made in the big Quilcene River from eggs shipped in from the Little White Salmon station. The collection of silver-salmon eggs was considerably larger than those of the past few years. This is probably attributable to the improved condition of the permanent traps in the Big and Little Quilcene Rivers. Over 2,000,000 eggs were collected, and 358,000 eyed eggs were received from the Quinault station. Due to shortage of space it was necessary to liberate a large number of these as advanced fry. A few humpback-salmon eggs were secured in conjunction with the collection of chum-salmon eggs of the early run in the Duckabush River. The same conditions that gave a larger collection of silver-salmon eggs was held to be responsible for a larger take of steelhead eggs. At the close of the year 366,000 fingerlings of this species were on hand, as well as 135,900 fry.

Sulton (Wash.) substation.—A temporary wire trap that had been built in the creek was washed out before the fish began running, and it was impossible to reconstruct it before the end of the season. While the run of chinook and humpback salmon probably was as large as usual, the above-mentioned conditions prohibited the taking of eggs. The run of silver salmon was quite large, and an average number of eggs was obtained. As many of the fish were green, it was necessary to pen a number of them. A total of 3,710,000 eggs was obtained. As this station has no rearing ponds it was necessary to liberate the resulting fish as advanced fry and a very small number of fingerlings. The number of steelhead eggs taken on Elwell Creek was above recent records, and it was also necessary to pen the resulting fish and distribute most of them as advanced fry. At the close of the year 112,000 fry and 138,000 fingerlings of this species were being retained.

Quinault (Wash.) Station

(Marcus S. Meyer, Superintendent)

While no extensive improvements were made to buildings or ponds, the discontinuance of the use of dirt ponds necessitated the construction of screen inclosures in Falls and Merriman Creeks to maintain the rearing capacity of the station. A new rack was built in Big Creek to replace the old trap. A total of 18,218,000 sockeye-salmon eggs was taken by seining between October 20 and December 5. During the same period nearly 3,000,000 silver-salmon eggs were obtained, but in order to relieve congestion in the hatchery the majority of these were transferred to other stations. A few chinook-salmon eggs also were secured in conjunction with this work. A number of shipments of sockeye and silver salmon eggs were made to State hatcheries in Washington and Oregon as well as to other stations of the bureau. Of a shipment of 209,000 eastern brook-trout eggs received in early December, 100,000 were planted in the eyed stage in isolated lakes and streams. All fry produced from the remainder, with the exception of about 2,000, were distributed by the United States Forest Service. The fiscal year closed with approximately 1,000,000 sockeye-salmon fingerlings on hand.

Clackamas (Oreg.) Station and Substations

(Philo B. Hawley, Superintendent)

The eggs collected in this field, including the main stations and its substations, aggregated over 4,000,000 in excess of those taken in the previous year. Chinook salmon and silver salmon, as well as the steelhead, rainbow trout, and brook trout, were the species handled.

Clackamas (Oreg.) station.—The 19 rearing ponds at this point were equipped with frameworks of 1½-inch galvanized-iron pipe to serve as a support for vines planted at the sides to provide shade in order to maintain a lower temperature during the summer months. It is hoped that this novel expedient will prove to be effectual as well as being inexpensive and ornamental. In the early fall the prospect for a satisfactory collection of chinook-salmon eggs appeared good. In late September, however, the water was extremely high, and débris soon collected on the rack, backing up the water and threatening damage to shore property. To avoid this it was necessary to dynamite a portion of the rack, and the continuation of high water prevented any attempt to reconstruct it. Consequently no eggs were collected.

A number of shipments were received from the State of Oregon and from substations of the bureau and a fair production of fingerlings resulted. Brook-trout eggs and steelhead eggs also were transferred to the Clakamas station during the year as well as 137,500 rainbow-trout eggs. Some of these were retransferred, but the majority were held for hatching, and the output was distributed in the fingerling stage. There were on hand at the close of the year 46,000 steelhead trout. The station was materially assisted during the year by the cooperation afforded by the Oregon Fish Commission and the Oregon Game Commission in connection with the distribution of fish and the transfer of eggs.

Little White Salmon (Wash.) substation.—Plans have been made to construct a cold-storage plant at this station for keeping the supply of fish food needed for all the bureau's hatcheries in this field. The foundation has been laid, and when completed the plant will have a storage capacity of about 70 tons. Two woodsheds were erected during the year, and minor repairs were made to buildings and grounds. The station is being equipped with fry trays as fast as possible. A number of skiffs were constructed for use at this and other stations. At the beginning of the year approximately 90,000 fingerling steelhead and sockeye salmon were on hand, which were distributed later in local waters. Favorable fishing conditions during the egg-collecting season permitted a take of 26,600,000 chinook-salmon eggs, approximately the capacity of the hatchery. It is estimated that 40,000,000 could have been secured had fishing been continued to the end of the season. A normal hatch was secured, and the fry were reared to the 1½ and 2 fingerling stages before being distributed in the Little White Salmon River. A shipment of brook-trout eggs was received in November, and the product was distributed as fingerlings No. 1, some to applicants and the remainder in waters in the Cascade Mountains.

Seventy barrels of salmon flesh were salted for fish food, and a considerable quantity of horse meat also was fed. The latter apparently is proving to be a very satisfactory diet.

Big White Salmon (Wash.) substation.—A combination workshop and garage was constructed during the year. This constitutes the only work of major importance in the way of improvements. A new cedar head trough was installed in the hatchery building, and steps were taken to provide an additional supply of fry trays. The collection of chinook-salmon eggs from the Big White Salmon River was the largest in recent years, a total of 14,906,000 being secured. The eggs were transferred from the racks to the hatchery in the green state, being carried by truck. Excellent results followed this method, and the hatch was normal. A number of eggs were carried successfully in this manner to the Clackamas station, a distance of nearly 75 miles. Spring Creek yielded more than 5,000,000 eggs, which was very satisfactory. This stream has been built up as a salmon stream entirely by artificial propagation, and it probably constitutes one of the most dependable and inexpensive sources for eggs in the Oregon field. Most of the chinook fry were reared to the No. 2 fingerling size before they were liberated in the river. A considerable amount of salted salmon, as well as 3½ tons of horse meat, was used in feeding this stock. The marking experiment initiated last year was unsuccessful, but the work was again taken up with the idea of ascertaining the benefits to be derived from holding fall chinook-salmon fingerlings over a considerable period. This station handled a number of brook-trout eggs and distributed 49,000 fingerlings of that species. The work of the station also included the incubation of 100,000 steelhead eggs and 75,000 rainbow-trout eggs for the Klickitat County (Wash.) Game Commission.

Rogue River (Oreg.) substation.—Minor repairs were made to the plant here. The collection of chinook-salmon eggs was only about half as large as that of the previous year, although fishing started on August 13 and was conducted continuously to September 26. No other eggs were taken at this station, but a consignment of sockeye-salmon eggs was transferred here from the Quinault field and a number of sockeye fingerlings resulting from the previous year's transfer were distributed.

Applegate Creek (Oreg.) substation.—Late in August temporary repairs were made to the fish barrier across Applegate Creek. A 60-foot break in the west end of the dam was repaired, and a new trap and pens were constructed. The satisfactory condition of the water during the spawning season of the silver salmon made possible a collection of eggs over three times as large as that of the preceding year. Favorable conditions prevailed during the steelhead run, also, though few fish entered the creek, and in spite of the reconstruction of the barrier the total number of eggs taken was below that of last year. After making the usual shipments of steelhead eggs in the eyed stage, the fry and the remaining eggs were transferred to the Butte Falls hatchery of the Oregon Game Commission for further development. This permitted the closing of the Applegate Creek station for several months and resulted in a reduction in the cost of operations.

Salmon (Idaho) substation.—At the beginning of the year 285,000 chinook-salmon fingerlings were being carried. Part of these were distributed, and the remainder were held for a marking experiment. While the run of salmon in the Lemhi River was a month late, 4,000,000 eggs were taken. A number of fish apparently spawned in the river below the rack. The eggs taken in this river were eyed locally and were then transferred to the Salmon (Idaho) hatchery for futher development. Sixty thousand fall and 65,500 spring chinook-salmon fingerlings were marked and liberated in the experiment mentioned above. No fish were liberated from the station until they had reached a length of 2 inches.

In connection with the work in this field a new collecting station for rainbow-trout eggs was opened at Williams Lake, Idaho. From April 23 to May 19 over 1,000,000 eggs of this species were secured, and after developing them to the eyed stage they were transferred to the Salmon hatchery.

Baird (Calif.) Station and Substations

(W. K. Hancock, Superintendent)

The major improvements made at the Baird station were the painting of several of the buildings and minor alterations and repairs. The fall run of chinook salmon in the McCloud River was very light, and a number of those

that ascended escaped through a hole in the rack. Egg collections were negligible, therefore. The small number taken were hatched in outside troughs fed by a spring, thereby obviating pumping. Over 1,500,000 eyed eggs were transferred from the substations to make up the shortage. High water during the winter washed out the intake dam. After part of the fish were planted, preparations were made to take care of the spring run of chinooks by rebuilding racks and traps. Shortage of water made the planting of the remaining fingerlings necessary. At the close of the season a few fish were in the traps.

Battle Creek (Calif.) substation.—A new power boat and a shed to house it were constructed during the year, and minor improvements were made. It was necessary to replace the racks at this point almost entirely. Fishing started October 2 and alternated between Battle Creek and the Sacramento River until high water stopped operations. About 2,000,000 eggs were taken. Late in November the racks were washed out, making further attempts to secure eggs useless. As usual, muddy water during the incubation season caused considerable difficulty. Fingerlings were planted intermittently until March, when high water made it necessary to plant a large number and transfer others to the rearing ponds. All of the stock was distributed by June.

Mill Creek (Calif.) substation.—Racks were installed and fishing began on October 29. Prospects were favorable until high water washed over the tops of the racks and liberated most of the fish that had been taken. A total of 3,405,000 chinook-salmon eggs was obtained, and it is probable that some 3,000,000 or 4,000,000 were lost due to the above-mentioned cause. Muddy water at this point also necessitated constant attention to eggs and fry. By early March over 1,000,000 fish were planted to provide room in the hatchery. During the latter part of the month a storm clogged the water-supply ditch, and all stock in the hatchery was distributed. Thereafter, until the close of the year, the station was inactive.

FISHES OF THE GREAT LAKES

In this field the number of whitefish and lake trout taken was smaller than ever. However, there was a considerable increase in the number of lake trout handled. Conditions in Lake Erie have changed so in recent years that the Put in Bay (Ohio) station is able to secure only a very limited number of eggs from what were formerly its most productive fields. Pike perch, yellow perch, and carp also are handled in conjunction with the propagation of the more important varieties at the four stations in this field.

Duluth (Minn.) Station

(S. P. Wires and Ward A. Cook, in charge)

In addition to painting the hatchery building and outbuildings, considerable work was done in replacing flumes, drains, etc., which had rotted. A new 20-horsepower tubular boiler was installed. Fish-cultural operations were conducted on a somewhat larger scale than previously. Due to a misunderstanding with the State fish warden, arrangements for the collection of whitefish eggs were not made until bad weather had affected the fish, and as a consequence the collections of eggs from this species did not meet expectations. An attempt was made in an experimental way to hatch a few lake herring. Satisfactory results were experienced with lake trout, over 27,000,000 eggs being collected and a fair hatch secured. A number of shipments of lake-trout eggs were made to other stations. A few fingerlings were being held at the close of the year. The usual cooperative arrangements were made with the State of Minnesota for the propagation of pike perch. The eggs were collected at the field station near Bemidji, Minn., and the bureau's share amounted to over 11,000,000 eyed eggs. A very good hatch was secured, and the resulting fry were distributed in local waters and to applicants in various parts of the State. The station also received 450,000 brook-trout eggs. A considerable number of fry died, but over 200,000 fingerlings were distributed and more than 15,000 were on hand at the close of the year. Reports received indicate that the work of stocking with lake-trout fry and fingerlings is showing effective results and that more small trout are being seen each year.

Northville (Mich.) Station and Substation

(W. W. Thayer, Superintendent)

At the main station a larger number of trout eggs was handled than in recent years. During the year 2,164,740 brook and rainbow trout eggs were received. The fry and fingerlings resulting from these were distributed to applicants and to the cooperative nurseries operated in conjunction with the Northville station. These agencies alone received 408,000 rainbow-trout fry and fingerlings. While the trout operations met with average success, the work with the pond-fishes, particularly the smallmouth bass, was retarded by a heavy loss among the brood stock. A number of these fish died during the winter, and virtually every one of a shipment of 220 adults received in the spring perished. The total distribution of bass for the year was slightly over 75,000. A few bluegill sunfish were distributed, and there is indication that the present season's hatch will produce a larger number.

Alpena (Mich.) substation.—In general, the operations in this field were satisfactory, and an extension of the work is foreseen for the future. Favorable weather conditions, coupled with cordial cooperation by the State of Michigan in allowing an extension of the fishing season and in detailing wardens to assist in making the collections, permitted the taking of 32,117,000 whitefish eggs. It is reported that previous plantings of whitefish in the vicinity of Alpena and Thunder Bay are showing satisfactory results in an abundance of young whitefish in these waters. The State also assisted by incubating surplus eggs at the Harrisville hatchery and in the distribution of the whitefish fry. A new field station was opened at Greenbush. The hatchery was filled to capacity with lake-trout eggs, but a rather heavy mortality was brought about by the chlorine in the water supply. The policy of planting lake-trout fingerlings in Devil River at Ossineke was continued, and it appears that an important fishery is being developed at that point. A lake-trout nursery with a capacity of 300,000 fingerlings has been established by fishermen's organizations. The fishermen have also rendered material assistance by lending equipment to be used in the distribution work.

A limited number of rainbow-trout and brook-trout eggs was handled at the station for distribution to nursery pools in the vicinity. Heavy losses were experienced with the rainbow trout, but the brook trout were placed in the ponds with only a normal mortality. An attempt to hatch chub eggs (Leucichthys sp.) was unsuccessful, virtually none of them producing fry. Although a large number of pike-perch eggs was secured, the hatch proved to be almost a total failure, due to very low water temperatures during the early part of the incubation period. There is every indication that this branch of the work can be developed to much greater proportions by assigning a larger crew for its prosecution. It is probable that other field collecting stations for whitefish, pike perch, lake trout, and cisco can be located in Lake Huron when the capacity of the Alpena hatchery has been expanded sufficiently to care for all eggs that may be secured. An attempt made to pen whitefish and lake trout was largely unsuccessful, there being a tendency for both species to become badly fungused, whether held in pens or in floating live cars in more or less open waters. Only a negligible quantity of eggs was secured from this source. The whitefish and lake-trout hatching equipment has been temporarily repaired so that it may be used pending the completion of extensive improvements to be undertaken in the coming year. An addition 30 by 35 feet in dimensions was made to the hatchery building, and a fresh-water supply pipe line was extended out into the bay. It is evident that the latter will have to be extended somewhat farther to insure a satisfactory water supply. Several acres of land adjoining the hatchery were leased during the year and will be used to improve the appearance of the station and permit the construction of auxiliary rearing facilities.

Charlevoix (Mich.) substation.—While this station handled a large number of eggs, the results of the season's work were not as satisfactory as might be desired. Most of the 42,700,000 lake-trout eggs collected were of very poor quality, and an inordinately low percentage of hatch was obtained. Eggs from Lake Superior fields gave the highest percentage of hatch, although they were shipped the greatest distance. It is probable that inexperience or unwillingness on the part of the fishermen to take the eggs was responsible to some degree for the poor success attained, as the bureau's employees and the State wardens made every effort to improve the quality of the take. Eggs from gill-netted fish apparently are much poorer than from those from fish taken

in pound nets. More than 35,000,000 whitefish eggs were collected, and almost 20,000,000 fry were distributed. The State fish car assisted during the spring in distributing the station stock of whitefish and lake trout. In collecting the eggs the State employees acted as messengers, delivering the eggs to rail points, and a much more expeditious delivery was effected in this way. A shipment of pike-perch eggs from Bay City, Mich., was received in such bad condition that virtually none hatched. Twenty-five thousand steelhead eggs were received in June, and the resulting fry were on hand at the close of the year. Minor improvements were made to the station property, and a new storage building was built.

Put in Bay (Ohio) Station

(David Davies, Superintendent)

No extensive improvements or alterations were made to the station plant. Painting, replanking the wharf, constructing a septic tank, and making extensive repairs on the steamer *Shearwater* were among the most important items. The propagation of whitefish was marked by the smallest number of eggs collected in recent years. The field stations at North Bass, Middle Bass, Put in Bay, Catawba Island, Port Clinton, and Toledo were opened, but the catch of fish was limited. While unfavorable weather prevailed during part of the season, weather conditions as a whole were not a great handicap, and no cause other than scarcity of fish can be assigned for the shortage. Whitefish seem to have left this end of the lake. The collections totaled 104,000,000 eggs, and all of the resulting fish were planted as fry. The spring pike-perch work was much more successful, and an abundance of fish was reported. The first eggs were received on April 8 and, while unfavorable weather was encountered, almost 500,000,000 eggs were obtained. As usual, the percentage of hatch was low, running around 33. Yellow perch were handled also, but the fishermen did not furnish many eggs of this species. About 4,000,000 eggs were put in wire baskets floating near the hatchery, and about 90 per cent of them hatched. The carp work in the Port Clinton field during the spring failed because eggs were secured from June 12 to June 25 only, and then only in very small numbers. The fishermen did not take many fish in their nets, and it is probable that high water permitted the fish to enter the creeks, where they could not be reached by nets. The usual collections of adult smallmouth black bass for brood stock at other stations of the bureau were made during the spring.

Cape Vincent (N. Y.) Station

(J. P. Snyder, Superintendent)

The most important improvements made were the construction of a new garage and the replacement of defective timbers in the dock. Work was started on a large bass pond on property owned by the bureau near the station. Due to the fact that the work was begun very late in the season and that there was a shortage of funds, the work planned was not completed. A pipe line was laid from the hatchery to the site of the future water supply. The engines in the boat *Curlew* were replaced by a Diesel power plant, and extensive repairs and alterations were made.

The lake-trout work was highly successful, and the number of eggs taken was virtually double that of any preceding year. The success was due partly to the penning of over 400 females at Carlton Island and Stony Island until their eggs ripened. The run of fish was normal, but favorable weather helped the spawn takers to collect 5,700,000 eggs. Some of the eggs were of very high quality, and after deducting 500,000 eggs shipped away there were hatched 3,220,160 fry. The number of whitefish eggs taken again dropped below the previous season's figures, the total number taken amounting to about 25,500,000. The collecting season was marked by a small run of fish and unfavorable weather conditions. The only area in which a scarcity of fish was not apparent was in Canada in the Bay of Quinte. The collection of 171,000,000 cisco eggs represented a moderately successful season, but here, too, it appeared that there was a decrease in the number of fish. Most of these eggs were collected in New York waters. One million three hundred and twenty-five thousand brook-trout eggs were received from commercial hatcheries and by exchange.

The fry were allotted to the various substations and to the five cooperative nurseries under the direction of this station or were distributed to applicants in New York. During the spring a shipment of rainbow-trout eggs was received from Michigan and incubated for subsequent distribution. A few Loch Leven trout also were handled.

Watertown (N. Y.) cooperative substation.—This plant, consisting of a battery of troughs, grinding house, and cottage is sponsored by the Jefferson County Fish and Game Association. In return for the use of the property and certain monetary assistance for fish food, etc., the bureau allotted 100,000 trout fry to the association. At the close of the year the bureau was carrying about 750,000 brook and rainbow trout for its own needs.

Barneveld (N. Y.) cooperative substation.—This is a large hatchery project leased by the Utica (N. Y.) chapter of the Izaak Walton League and operated by the bureau. At the beginning of the year over 250,000 brook, rainbow, lake, and Loch Leven trout fingerlings and yearlings were on hand. During the early fall a severe epidemic broke out, and as it seemed to be beyond remedy it was decided to dispose of all the stock on hand, either by distribution or by destroying the infected individuals. The plant was then thoroughly disinfected, and about 300,000 brook and rainbow trout eggs and lake-trout fry were shipped in during the winter. At the close of the year the fish were doing well, and there was little indication of a recurrence of the mortality of the previous year.

The Cape Vincent station also administered four smaller nurseries situated in Vermont and New York. These were uniformly successful.

Swanton (Vt.) substation.—In the fall of 1927 a 5-year agreement between the State of Vermont, the State of Pennsylvania, and the Bureau of Fisheries for the continued operation of the Swanton substation was entered into. As usual, the bureau was in full charge of the work. The expenses were prorated among the cooperative agencies, and the fry were allotted on an equitable basis, 40 per cent being returned to parental waters, 40 per cent being allotted the State of Pennsylvania, 10 per cent to the bureau, and 10 per cent for general applications held by the State of Vermont. A new 30-foot motor boat was constructed, and a number of live cars for holding fish until ripe were provided.

Preparations for work were begun on March 15, and it was found necessary to conduct extensive seining operations under the ice, as it appeared that the fish were ripening in advance of the break-up. No trap nets were used until April 20, and a large percentage of the fish had spawned by that time. Collections were continued until May 6, when 3,275 pike had been penned. These produced 137,060,000 eggs, and slightly less than 100,000,000 fry were hatched and distributed according to the agreement. In conjunction with this work, eyed yellow-perch eggs were collected and hatched. The majority of the fry were planted in Lake Champlain, but a small percentage was distributed in other waters in New England and New York.

RESCUE OPERATIONS

This division carries on rescue work on the upper Mississippi River and is charged with responsibility for the bureau's activities in the Upper Mississippi Wild Life Refuge. Propagation of carp and buffalo fish in the lower Mississippi is also part of its duties. At the headquarters at La Crosse, Wis., large numbers of trout are now propagated. General supervision of all the fish-cultural work carried on between the Rockies and the Appalachian Mountains is delegated to this division.

La Crosse (Wis.) Station and Substations

(C. F. Culler, in charge)

Several rowboats, a house boat, and a 32-foot cruiser were built during the year for use in the Upper Mississippi River Wild Life Refuge. Buffalo fish were not propagated in Louisiana during the year, but a crew carried on some experimental hatchery work with this species in cooperation with the State of Arkansas. The territory covered was more extensive than last year, and the

number of fish handled was greater. Extensive trout-hatching operations are now conducted at the La Crosse station. Brook-trout and rainbow-trout eggs were obtained from the bureau's stations in Missouri and Iowa and from the Pend Oreille County Fish and Game Commission through exchange. A number of Loch Leven-trout eggs also were incubated, but the fry suffered a rather heavy mortality. The demand for this species in Wisconsin and Minnesota appears to be increasing. The Lincoln Park Aquarium at Chicago incubated a number of rainbow-trout eggs, the fry from which were distributed under the direction of the La Crosse station. Inasmuch as the capacity of the La Crosse station is insufficient to handle the full number of fish needed, the surplus is transferred to the substation at La Crosse and to the Lynxville auxiliary pending distribution.

Much of the time of the La Crosse station personnel is taken up in administering the many cooperative nurseries in that territry. Thirty-nine nursery projects, having a total of 49 ponds or tanks, are now in operation under the bureau's direction in Minnesota and Wisconsin. The rescue operations were very successful. In the upper Mississippi River field 145,176,900 fish were handled. The usual small percentage, amounting to four-tenths of 1 per cent, was distributed to other waters on application. The rest of the fish were returned to parental waters. The cost of the work amounted to approximately $0.126 per thousand fish rescued. Certain areas formerly handled by the bureau were covered by the States of Wisconsin and Iowa. In connection with the rescue work, almost 2,000,000,000 larval mussels were released in the parasitic stage on rescued fish. The aggregate number of trout hatched was over 1,500,000.

Homer (Minn.) substation.—The construction of new boats and equipment and the overhauling of engines, machinery, boats, and trucks were the important features of the work at this substation. Fish-cultural operations are confined to rescue work, as the water supply is unsatisfactory and inadequate for the successful hatching of eggs. This work is limited, however, and the station is used chiefly as headquarters for construction and repair work on boats and as a center for work in the upper Mississippi River wild life refuge. It is planned to build propagating ponds in the refuge, and then the location of the Homer substation will make it the logical headquarters for the supervision of that work.

Marquette (Iowa) substation.—During the year this substation rescued more than 50,000,000 fish, the territory covered including areas around Guttenberg and Buena Vista, Iowa. Mussel-infection work also was carried on.

Bellevue (Iowa) substation.—In addition to the usual rescue work eggs of the buffalo fish and carp were collected, fertilized, and planted, and some mussel-infection work was done.

Lynxville (Wis.) substation.—Ten galvanized-iron holding tanks, capable of holding about three carloads of fish, were added to the equipment of this station. These will be of material assistance to the distribution work during periods of low water. Electric-light lines also were installed. The work at this substation consists chiefly of rescuing the commercial species and the catfish. It also collects mussels and sends them to the field crews for infection. During April, May, and June surplus trout from the La Crosse station were handled at Lynxville. The results of this work are described in the section of this report dealing with the La Crosse station.

Mussel Infection

[Conducted by the Fairport (Iowa) and La Crosse (Wis.) stations in conjunction with the rescue of landlocked fishes]

The customary work of infecting rescued fishes with the larvæ obtained from gravid mussels of the commercial varieties was continued. At La Crosse 1,915,435,750 glochidia of various species were released on fishes, while at the Fairport biological station 139,069,400 young mussels were planted in connection with the rescue of 2,405,194 fishes and the hatching of over 80,000. This large number of larvæ was handled at a cost ranging at from a little over 1½ to 43¼ cents per thousand, depending upon the location of the work. The total output surpassed that of the previous year, though it did not reach that of some of the earlier years.

MARINE SPECIES

Aggregate collections of cod, haddock, and winter-flounder eggs at the two stations in Massachusetts and the station in Maine exceeded the total for last year. There was a decline in the number of pollock eggs taken, but approximately 50 per cent more cod eggs were handled than in previous years. Fertilized cod eggs were planted directly on the fishing grounds because it is impracticable to incubate them in the hatcheries. This work is prosecuted in the Massachusettes offshore fishery and at the Boothbay Harbor (Me.) station.

Boothbay Harbor (Me.) Station

(E. E. Hahn, Superintendent, and J. R. B. Rogers, Acting Superintendent)

A number of the buildings at this station, including the hatchery and residences, were painted, and minor repairs were made to the lobster pound at Pemaquid. In addition, the work necessary to maintain the extensive equipment of boats, docks, and pumps was done. During the winter ice caused considerable damage to the pound. The steamer *Gannett* was again out of commission pending the provision of a new boat to replace it. The usual summer exhibit of seals, fish, and other aquatic life was maintained. The fish-cultural work consisted of hatching flatfish and fertilizing and planting cod eggs on the spawning grounds. While collections of eggs of the former were not so large as in some previous years, the percentage of hatch was above normal and the work was very successful. An open winter made it possible to set fyke nets for brood fish from March 1 to April 30. Over 2,000,000,000 fry were hatched from the 2,136,970,000 eggs handled, a percentage of over 94. The hatchery was filled to capacity at the end of 16 days' fishing, and it was necessary to hatch the surplus in floating boxes moored off the dock. Very successful results attended this method. On April 1 chartered vessels took up the collection, impregnation, and liberation of cod eggs off the harbor. The latter work was resumed last year after a lapse of several years. Over 1,250,000,000 eggs of this species were handled.

Gloucester (Mass.) Station

(C. G. Corliss, Superintendent)

During the summer, when no fish-cultural work was in progress, the station boilers were retubed, and extensive repairs, amounting virtually to reconstruction, were made to the marine railway. The station buildings were cleaned and painted, also. The collections of pollock eggs were the smallest in many years, and while the weather was responsible for this condition to some extent there is no explanation as to why the catches of fish were so small.

Cod-egg collections began late, but the take of eggs was satisfactory, and the total number secured was above the average of recent years. While comparatively few cod were caught on the inshore grounds, a very large percentage of them contained ripe eggs, and to this fact may be attributed the success of the work. It was possible to hatch all eggs collected prior to April 28, but, as usual, variations in the density of the water after that time necessitated the planting of the eggs immediately after fertilization. A total of 741,915,000 cod eggs was handled.

There was no large body of haddock on the inshore grounds, so that the slightly more than 250,000,000 eggs taken during the season were derived chiefly from one boat. The spring flounder-fishing operations resulted in a catch of 523 adults in fyke nets. From these 221,480,000 eggs were secured. A very satisfactory number hatched, and the fry were planted locally.

Arrangements to fertilize cod eggs on the offshore fishing grounds were made during February and March. Three spawn takers did this work, and the results were about the same as in recent years. Some haddock eggs were handled also in connection with this field work. It is notable that the haddock eggs were taken by otter-trawl vessels, while the majority of the cod eggs were secured by hand trawlers.

Woods Hole (Mass.) Station

(G. R. Hoffses, Suprintendent)

In addition to its regular work with cod and winter flounder, the station again undertook the propagation of mackerel during the spring. Sheathing and painting of walls, rearrangement of the chem.cal laboratory for more efficient utilization of the space, and the partitioning of two more laboratory rooms were done during the year. A rusted steel beam in the foundation of the building was replaced with a wooden one. Additional toilet facil.ties were installed in the residence building. All roofs were thoroughly overhauled, and the gas line was extended into the buildings. Bituminous coal was used satisfactorily in firing all of the boilers instead of the expensive hard coal heretofore used. A new engine was installed in launch *No. 30*.

A stock of brood cod was secured from traps at Newport, R. I., and from local hand-line fishermen. Fish to the number of 3,456, virtually the capacity of the retaining pool, were obtained. A boat equipped with a well was chartered for transferring the fish from Newport, and the losses hitherto experienced were largely eliminated by simply reducing the speed of the vessel to about twice the normal running time. Over 230,000,000 eggs were taken, which proved to be of average quality. Egg collections were slightly smaller than those of last year, though a larger number of fish was on hand. In January the first fyke nets were set at Waquoit, Mass., to catch winter flounder. Operations with this species in Rhode Island waters were discontinued because changing conditions have rendered it difficult and unprofitable to work in this field. A stock of 3,979 flounders was secured, and from January 25 to March 15 over 695,000,000 eggs were taken from them. Hardening of the eggs was again the cause of considerable mortality. An attempt was made to fertilize the eggs by the incision method, but with little success. The flounder eggs as well as the cod eggs showed a slightly higher mortality under a closed-circulation water supply than when the open system was employed. Eggs of the mackerel were obtained from near-by traps, which were visited regularly for the purpose of securing specimens. Over 6,000,000 eggs were secured and incubated. Observations on alewives and white perch in near-by waters were made with the object of obtaining data as to the practicability of propagating these forms. The findings indicate that the probable results would not be commensurate with the effort involved. The usual exhibit of live fish was maintained during the summer and attracted considerable attention.

ANADROMOUS SPECIES, ATLANTIC COAST

An unusually heavy run of shad in the Potomac River and a much larger number of eggs taken at the Edenton (N. C.) station made it possible to increase the number of fish hatched by 100 per cent over last year. The hatching of striped bass on the Roanoke River at Weldon, N. C., was carried on by the Edenton station. Propagation of the Atlantic salmon in Maine was made possible by a continuance of the practice of obtaining the eggs from the Canadian Government on an exchange basis.

Bryan's Point (Md.) Substation

(L. G. Harron, Superintendent)

The largest catch of shad for a number of years in the Potomac River was reflected in a very successful season at the bureau's most important shad station. The station was opened in March, as usual, and a sufficient stock of adult yellow perch was secured from fishermen to produce over 138,000,000 fry for distribution in Potomac waters. The run of shad was somewhat late in starting, but fish were very abundant when the run became established. Over 43.000.000 eggs were obtained by the close of the season late in May, which yielded nearly 41,000,000 healthy fry. This output was virtually 100 per cent greater than that of the previous year.

At the close of fish-cultural operations the work of dismantling the station was begun preparatory to transferring it to a new site at Fort Humphreys, Va.,

on the opposite side of the river. At the close of the year all preliminary work at the new site, including the construction of docks, was completed, and the necessary buildings were in course of erection.

Edenton (N. C.) Station and Substation

(William S. Vincent, Superintendent)

Herring-collecting operations closely approximated the work of former years. Weather conditions were somewhat adverse, but over 220,000,000 eggs were taken. Only about 20 per cent of these hatched, but this is about the average of former years. It is very gratifying to report that the production of shad was larger than usual. The station depends upon a single fishery for its supply of eggs. This year only about 20,000 fish were taken, 5,000 less than last season. However, there was a much larger percentage of ripe roe shad in this number, and about 8,000,000 eggs were obtained. On several occasions the collecting launch was unable to reach shore, which made it necessary to fertilize the eggs and plant them immediately. Shad fishing in upper Albemarle Sound was better than for several years past. It is difficult to explain this condition, in view of the very poor catches of the past few years.

From a stock of 800 adult yellow perch over 11,000,000 eggs were obtained, and a very large percentage of them hatched. At this station, brood yellow perch are placed in the ponds and bundles of small branches are distributed at various depths. The eggs deposited adhere to these branches, which are then collected and the eggs transferred to hatching jars for incubation.

Weldon (N. C.) substation.—The hatching of striped bass at this point, which had been discontinued since 1923, was resumed on May 1, 1928. Hatching equipment from the Edenton station was transferred to Weldon, and other necessary apparatus was furnished by the State of North Carolina, which cooperated in the work. The Roanoke River was extremely high, the weather was unfavorable, and the fluctuation in water level seriously hampered fishing operations. Consequently the collection of eggs was not as large as had been anticipated. A very good percentage of hatch was secured, however, and no trouble was experienced from polluted water, which was the deciding factor when the work was discontinued in 1923. About 7,000,000 fish were hatched and planted in the Roanoke River adjacent to Weldon.

FISHES OF MINOR INTERIOR WATERS

This numerically insignificant proportion of the bureau's output consumes a disproportionate share of the funds and facilities provided for fish-cultural work. Virtually every mile of stream in the country and every pond or lake of an area greater than 1 acre is a potential depository for Government fish, not only once but continually, in view of the constant drain on fish life imposed by heavy fishing.

It is obvious that the product of 23 hatcheries must fall short of meeting such a demand. The bureau recognizes further that the efficiency of a station can not be measured by the number of fish produced alone, but by the size and condition of the fish as well. The various trout and pond stations have therefore been put to the necessity of devising expedients for the production of larger fish at the same time that they are producing more of them. In most instances, where physical limitations permit, this requirement has been met, as the constantly increasing records of production will show.

While trout can not be reared at strictly pond stations, the warm-water varieties can be propagated in conjunction with other forms. Consequently these stations are able to distribute a limited number of bass in addition to the trout they produce. The supply, however, is insufficient to compensate for the general shortage of warm-water varieties, and the bureau is obliged to fill requests for 15 or 20 cans of fish with one-third that number.

ROCKY MOUNTAIN TROUT STATIONS

This group of stations, six in number, maintains a high rate of production but is required to take care of a very extensive range of territory from the coast ranges to the Middle West. As headquarters for field operations, they are able to divert surplus eggs to State hatcheries and other bureau hatcheries. Several of these hatcheries have attained new high records of production during the past year.

Bozeman (Mont.) Station and Substations

(W. T. Thompson, Superintendent)

Extensive development of the main station and its substations took place in this field during the year. A new 18-inch water-supply line was run from the spring to the hatchery and pond systems. This work was not entirely completed at the close of the year, but it will soon be finished. A number of rearing ponds were remodeled entirely. Extensive improvements to the superintendent's and foreman's residences were made, and still more work along this line remains to be done. The old wooden bridge on the station reservation was replaced with a new steel and concrete structure. The food house was moved and placed on a new concrete foundation.

The fish-cultural work has been exceeded by the record of one year only, and in certain respects, particularly in the Loch Leven-trout work, the past year's operations constitute a record. The development of Octomitus among the brook-trout fingerlings was the most serious setback of the year. Fully one-half the stock was lost due to this disease. The use of warmer spring water than heretofore resulted in more rapid growth of the black-spotted and rainbow trouts, and these fish were of a suitable size for distribution at an earlier date than in any previous year.

Much of the success in the Bozeman field is due to the hearty cooperation extended by the State of Montana. Many exchanges of eggs have been effected, and arrangements were made in some cases for distributing fish from the State hatcheries, thereby effecting considerable saving in the bureau's work. The State also made an outright donation of over 2,000,000 grayling eggs. All brook-trout eggs were received by purchase or exchange or by transfer from other stations of the bureau. The fingerlings on hand at the opening of the year exceeded 500,000, and these were distributed during the remainder of the year.

There was also established on Federal land, controlled by the livestock experiment station at Miles City, Mont., an 80-acre bass pond. The work was carried on jointly by the State of Montana and the bureau's employees, the State furnishing all money needed for the construction. While this pond has received no brood stock as yet, it will be completed in time to produce fish next year.

Meadow Creek (Mont.) substation.—A small cabin for the accommodation of spawn takers was constructed at Odell Creek during the year, and a 2-car garage was provided for the substation on Meadow Creek. This station has been equipped with an electric-power line and is now wired for both light and machinery. The number of Loch Leven-trout eggs collected at this point again exceeded previous records, with a total of almost 15,000,000 eggs. Nearly half of them were transferred by truck to Bozeman and other stations in the green stage, this method of shipment proving satisfactory in every way. Over 7,500,000 eyed eggs were shipped later, and the output of eggs in the green and eyed stages amounted to 96½ per cent of the total collection. The season's operations with the rainbow trout were somewhat disappointing. Weather conditions during the spawning season were not markedly unfavorable, but the run of fish was small, and less than 2,500,000 eggs were taken. These were of excellent quality, and 90 per cent were brought to the eyed stage. Nearly 700,000 fingerlings of this species were returned to the parental waters. This station also handled native black-spotted trout, which were furnished by the State to be planted on a cooperative basis. At the opening of the year 1,500,000 eggs of this species were on hand, and the resulting fry were planted in near-by waters. A consignment of 730,000 eggs was received in June and was on hand at the close of the year. Grayling eggs furnished

by the State were hatched also, and 1,850,000 fry of that species were produced and distributed.

Glacier Park (Mont.) substation.—The 1,500,000 black-spotted and rainbow-trout eggs on hand at the opening of the fiscal year were hatched, and the resulting fry and fingerlings were distributed in Glacier Park waters under the cooperation of the park service. Grayling fry to the number of 725,000 were also planted in the waters of the park. Twenty-five thousand eyed eggs of the golden trout of California were furnished to this substation late in the year through the courtesy of the California Fish and Game Commission. These will be hatched and the product planted in high-altitude lakes.

Leadville (Colo.) Station

(C. H. Van Atta, Superintendent)

The extensive equipment of the Leadville station enables the station force to accomplish important development work without recourse to outside assistance. During the year the water-power line was extended to the new shop building and connected with a water wheel for operating a sawmill and other machinery. The shop building, which is 36 by 50 feet and has two stories, was virtually completed, and foundations were laid for a large garage building. A sawmill outfit was purchased, and over 30,000 feet of logs were cut into flooring, sheathing, and molding.

Seven field stations, consisting of private lakes of varying size and number, were worked for brook or rainbow trout eggs. These operations are conducted on a share basis, the bureau generally supplying the men and equipment and allotting a portion of the eggs taken to the owner of the property. Almost 7,000,000 eggs of the two species mentioned above were secured in this manner. In addition to the work with these species, the Leadville station received shipments of black-spotted, Loch Leven, and lake trout eggs from other stations. One hundred thousand Loch Leven and 190,000 block-spotted trout fingerlings were on hand at the close of the year.

Yellowstone National Park (Wyo.) Substation

(C. F. Culler, in charge)

Inasmuch as a crew was unable to reach the station until June 4, the major portion of the work in this field was done in the fiscal year 1929. The season was unduly late in starting, and the first eggs were taken about a month later than last year. Aside from the usual repairs required by buildings unused a great part of the year, a new pipe line almost a mile long was laid from the head of Soldier Creek to the site of the new hatchery to be built during the 1928 season. An intake dam was constructed and fenced and the water conducted to a collecting basin about halfway to the hatchery site. The hatchery dock also was extended and repaired.

The take of eggs, amounting to 13,300,000, was below normal, although it slightly exceeded that of the previous year. Over 50 per cent of the eggs were secured from streams of the South Arm, although 12 streams were fished. Distribution of fry to distant points on Yellowstone Lake was facilitated by placing troughs on the boat and utilizing a small artificial pump for the water supply. The fry can thus be transferred without loss while they are still on the trays. The incubation of the eggs was more successful than last year, approximately 88 per cent having been fertile. A continuation of the plan followed last year of detailing a park employee to conduct parties through the hatchery and explain its operations has resulted in a minimum loss of time from fish-cultural work from interruptions. Thanks are due to the superintendent and other officials of the park staff for their aid and cooperation in facilitating the operations of the bureau.

Saratoga (Wyo.) Station

(S. M. Ainsworth, Superintendent)

Only minor repairs were made to the water-supply system, station buildings, and grounds, as it was anticipated that more extensive improvements would be made under the special appropriation that will be available during the com-

ing year. The collections of brook-trout eggs made by the field station at Big Creek Lakes were somewhat smaller than in previous years and fell short of last year's figures by approximately 100,000. The station brood stock of brook trout yielded about 300,000 eggs, and a number of eggs were received from other stations, which made possible a satisfactory spring distribution and left 738,000 fingerlings on hand at the close of the year. Considerable trouble was experienced with the eggs taken in Big Creek Lakes, and the losses were heavier than normal. A fairly satisfactory number of eggs was derived from the Loch Leven brood stock, although a serious loss occurred among these fish just at the opening of the spawning season, due to the clogging of a supply pipe to one of the ponds. In the Lost Creek field 3,272,000 rainbow-trout eggs were collected, approximately 800,000 of which will be used for stocking parent waters. A shipment of black-spotted trout eggs was received from the Yellowstone Park in July, 1927, and the resulting fry were distributed during the fall. A shipment of early black-spotted trout eggs was received in April, 1928, from the State of Nevada, to be replaced later with eggs from the Yellowstone Park field. In this way fish are brought to the fingerling size much earlier, making it possible to handle them in conjunction with the distribution of brook and rainbow trout. The Saratoga station carries over a large stock of all three species, as its distribution begins late and is carried on through the end of the fiscal year.

Spearfish (S. Dak.) Station

(D. C. Booth, Superintendent)

The pond system at this station was enlarged and improved. A pipe line will be laid from the source of supply in the city park to the concrete ponds in order to increase the volume of water. A substantial concrete wall was built along both sides of the main-entrance driveway. The usual cooperative fish-cultural work was carried on with the State of South Dakota. The State paid for approximately 2,000,000 brook-trout eggs purchased from commercial dealers, and the station furnished a number of Loch Leven trout eggs, which were repaid with brook-trout eggs from this shipment. Over 1,220,000 fingerling trout were distributed in various parts of the State under this arrangement, and it is felt that the results obtained justify a continuation of such work. A number of commercial fish-cultural projects have been established recently in the Black Hills territory, and the station personnel has been able to render some assistance and advice in this work. A satisfactory take of eggs from the station stock of brook, Loch Leven, and rainbow trout was secured. Almost 1,500,000 trout of the three species were distributed from the bureau's stock of fish.

Springvile (Utah) Station

(Claudius Wallich, Superintendent)

In addition to painting all the station buildings, certain repairs were made to some of the station ponds. The station brood stock of rainbow trout produced over 1,500,000 eggs, of which about 70 per cent hatched. The distribution of the young fish resulting from these eggs was in progress at the close of the year. At the opening of the year there were on hand almost 500,000 rainbow-trout fry hatched from eggs taken at Fish Lake during the preceding spring. By June 30, 1928, all of these had been distributed with the exception of 10,000, which are being reared to replenish the brood stock.

Wild rainbow-trout eggs were taken on April 10 at Twin Creeks. As this collecting field is conducted in cooperation with and under the supervision of the State of Utah, the total number of eggs collected (about 6,000,000) was divided between the two agencies, the bureau receiving 1,523,000 eggs of average quality as its share. A number of eggs were shipped to Honolulu, and the fry from the remaining stock are being reared for fall distribution. While the rainbow-trout eggs were being taken, a number of fish that appeared to be silver salmon were noted. These fish were in poor condition, and a number of eggs that were taken and fertilized failed completely to show any development.

Brook-trout eggs were collected in the Twin Creeks field in October and November. The run of fish was good, and 2,606,000 eggs were secured for the bureau's work in addition to about 4,300,000 allotted to the State. All but

800,000 of the bureau's eggs were shipped to other points. A great many of the fry hatched from the eggs retained at this station died, but those that survived developed well and were reared to fingerling No. 2 size and distributed in the spring. Eggs from the same lot shipped to the Saratoga station failed to develop this trouble, and the heavy mortality can not be explained.

On July 28, 1927, a cloudburst caused the Rock Canon Creek to overflow its banks and flood the station grounds, which were covered with a thick layer of mud; but the water supply was so situated that it was not affected, and apparently no fish were lost.

NEW ENGLAND TROUT AND SALMON STATIONS

The intensive drain upon waters of the populous northeastern section must be counteracted by the output from the hatcheries situated in Maine, New Hampshire, Vermont, and Massachusetts. The Craig Brook (Me.) station is the only agency in the United States, outside of several of the Maine State hatcheries, that handles the Atlantic salmon. It is also one of the few hatcheries that propagates the landlocked salmon.

Hartsville (Mass.) Station

(E. P. Thompson, Acting Superintendent)

Attention to routine work and necessary maintenance and repairs to buildings, equipment, and grounds constituted the only activity, outside of fish-cultural work, of the Berkshire hatchery. The spring-water supply was above normal in abundance during the spring months, and it is believed this was the cause of producing a very satisfactory output of fry and fingerling fish. The station brood stock of brook trout yielded approximately 275,000 eggs, and from these and a lot of eggs purchased from a commercial fish-culturist approximately 300,000 fry were obtained. A number of rainbow-trout fingerlings held over from the previous season were distributed, as were a lot of lake-trout fingerlings. The station received 500 adult horned pout and about 100 smallmouth black bass. Weather conditions during the spring appeared to militate against obtaining favorable results from the latter. In contradiction to the usual situation at this station, there was only a normal loss of fry after hatching, and the fingerlings showed good growth and only slight losses at the close of the year. A carload shipment of brook trout to Pennsylvania was made during the spring, and the station distribution was carried on intermittently to the close of the year.

Craig Brook (Me.) Station and Substations

(George N. Montgomery, Superintendent)

Extensive improvements to the buildings, grounds, and water supply were made during the year. A sluiceway was constructed in Craig Brook to handle the brook flow, and a flume was built to conduct water from the intake tank at the brook for the south ponds. Four ponds in the above system that had been out of service for a number of years were dug out and cement inlets and outlets supplied. On the west side of this system five similar ponds were likewise put in usable condition. A dam across Craig Brook near the lower hatchery was completed, and by the installation of racks and screens a raceway capable of handling at least 50,000 fish was formed. Repairs were made to the main cement supply dam, and the reservoir above this is now available as a rearing pond. In addition to this and other work, which materially increased the station's capacity, the buildings were kept in good repair and many minor improvements effected.

Brook-trout eggs obtained from the station brood stock amounted to almost 1,500,000, and more than 1,100,000 of these hatched. All of these fish were distributed at various ages, with the exception of 73,600 that are being held over for distribution in the fall. A number of brook-trout eggs from commercial sources and from exchanges also were handled, giving additional fingerlings for distribution. The station opened the year with more than 250,000

brook-trout fingerlings carried over from the previous year. These were distributed in the fall of 1927, with the exception of the small number reserved to keep up the station brood stock. All of the 42,070 landlocked salmon on hand at the beginning of the year were distributed. A small number of landlocked-salmon eggs were obtained during the fall collections at Green Lake and Grand Lake Stream auxiliaries, as well as over 200,000 from the State hatchery at Caribou, Me. Slightly over 100,000 fingerlings of this species remained on hand on June 30 for distribution later in the year.

A few Atlantic-salmon fingerlings on hand at the beginning of the year were distributed. Over 1,500,000 eggs of this species were received during the winter from the Canadian Government. Several shipments of 50,000 eggs were made to various State hatcheries in Maine. The fingerlings resulting from the eggs retained at the station exceeded 1,000,000, and these were distributed during the spring by the fisheries car and by the State wardens in suitable streams in eastern Maine. Small numbers of smallmouth black bass and white perch were secured in Green Lake and furnished to applicants in other parts of the State. The collection of humpback-salmon eggs from Dennys River was discontinued, as it was felt that the small demand for these fish could be adequately taken care of through natural reproduction.

Grand Lake Stream (Me.) substation.—The development of this station into an important auxiliary of the Craig Brook station has continued. Three new rearing ponds were constructed in an old canal. Each one, being approximately 25 by 100 feet, will carry 65,000 to 75,000 trout or salmon fingerlings. Similar ponds previously constructed have given splendid results. A new woodshed was constructed.

During the early part of the year 160,000 landlocked-salmon fingerlings held over from the previous year were distributed. Collections of eggs of this species were begun in October, but as usual the closing of the gates at Grand Lake Dam dispersed the fish and reduced the size of the take somewhat. The final figures showed a total of 739,550 eggs. Among the fish taken was a very large number of young males weighing about a pound and a number of small females spawning for the first time. This is a source of gratification, as it indicates the effectiveness of the stocking done in the past. In late November a heavy mortality of eggs occurred, particularly among the older ones. Treatment with glacial acetic acid was effective in immediately checking the loss. One hundred and seventy-five thousand fingerlings were placed in the rearing ponds, and the remaining survivors were distributed during the spring. The year opened with 50,000 brook-trout fingerlings on hand. These were distributed shortly afterwards, because the rising temperature of the water made it inexpedient to hold them. The station received 350,000 brook-trout eggs from commercial dealers in the fall. The majority of the fish hatched from these were liberated as advanced fry, but over 100,000 were retained in the rearing ponds for subsequent distribution as larger fingerlings. All reports indicate that past stocking has been effective and that catches of brook trout are very satisfactory. This substation has only one statutory employee, and the increase in the number of fish handled emphasizes the need for another permanent man.

Green Lake (Me.) substation.—With the exception of the collection of approximately 25,000 landlocked-salmon eggs and a few bass, this station was on an inactive basis. The old boathouse was torn down.

St. Johnsbury (Vt.) Station

(A. H. Dinsmore, Superintendent)

The November floods damaged the intake for the water supply from Sleeper River. It was necessary to make temporary repairs on the dam in order to operate the hatchery during the winter, and permanent repairs will be made as soon as possible. At the main station a large number of brook-trout eggs secured from the York Pond substation and from commercial dealers by purchase or exchange were hatched and the fish resulting therefrom distributed in the advanced-fry stage. Approximately 600,000 brook-trout eggs were hatched for two local fish and game associations. A few steelhead eggs of poor quality were taken from station stock, and a small number of salmon eggs transferred here were hatched. The station also cooperated with the State of Vermont in taking lake-trout eggs at Lake Dunmore, but the results were not up to expectations.

York Pond (N. H.) substation.—The construction of a commodious extension to the mess camp was begun at this station. In continuation of the extension of the pond and ditch system, several thousand feet of new pipe line were laid to the power house and hatchery and to a proposed new pond. One of the canals was extended and strengthened. Two new ponds were constructed and a third started. New raceways were laid out, and the hatchery capacity was augmented by three new double troughs.

With regard to fish-cultural work, 1,600,000 brook-trout eggs were collected, which is about three times as many as were taken last year. The brood stock was carried through with virtually no loss. Approximately 10,000 wild fish were caught by hook and line and reserved for future brood stock. Adult fish were removed from the stock ponds with traps, seines, and by the use of quicklime to stupefy them after the ponds had been drawn down. An unusual degree of success attended the rearing of the young fish. It is thought that losses among them were held to a minimum because it was possible to control the temperature of the water by means of a new supply from Cold Brook. At the close of the season many fish were being held in water having a temperature of 65°, with no detrimental effect. Small females were left in the raceways and allowed to spawn naturally, with the result that a considerable number of fry were secured in this manner.

Nashua (N. H.) Station

(J. D. DeRocher, Superintendent)

One of the major items of repair work at this station was the completion of the upper supply pond by grading the shores. Part of the pipe line from this pond to the nursery ponds was laid, and a new bass pond was completed with the exception of placing sand and gravel along its margins. The station carried a brood stock of both brook and rainbow trout, and during the fall the former yielded 136,160 eggs while 315,190 eggs were obtained from the latter. A small number of rainbow-trout eggs also was taken from wild fish at the Lebanon (N. H.) collecting station in the spring. Over 1,000,000 brook-trout eggs were obtained from commercial hatcheries and by exchange. Extremely heavy losses were experienced with both the brook and the rainbow trout, so that the distribution was somewhat limited. However, the distribution of the brook trout as a whole for the year was fairly satisfactory, and the fiscal year opened with 522,245 fingerlings No. 2 on hand. There were also almost 100.000 fry and fingerling rainbows in stock at that time. All fingerlings of both species were distributed in the fall of 1927. During July, 1927, about 15,000 smallmouth bass fry were collected from near-by waters. A few catfish also were handled. Almost 10,000 landlocked-salmon fingerlings were on hand at the close of the year.

COMBINATION TROUT AND POND STATIONS

The production of warm-water species at this group of five stations is supplemental to the propagation of trout. They are situated near the border line for cold-water fish and consequently meet a demand for fish adapted to widely varying conditions. The individual reports show that a high rate of production of incompatible species at the same hatchery can not be maintained.

Erwin (Tenn.) Station

(A. G. Keesecker, Superintendent)

During the year the station plant was improved by the construction of approximately 500 feet of concrete wall to protect the pond embankments. Two terra-cotta pipe lines were laid to provide additional water for some of the ponds. The construction of a new highway through the station grounds has caused the surface wash to enter the supply canal and ponds. Wooden outlets and drains were replaced with new ones of concrete. Several thousand cubic feet of mud and filth deposited by this wash were removed from three of the ponds. A new galvanized-iron roof was put on the carpenter shop. While the improvements made during the past year have to some extent offset the damage

caused by the new road, it will be necessary to make further changes and particularly to build a concrete basin for retaining the water before the trouble can be eliminated completely.

Over 1,000,000 rainbow-trout eggs were taken from the station brood stock between the months of November and February. Two lots of brown-trout eggs were incubated at the station for private parties. All brook-trout eggs handled were purchased from commercial dealers, and an average number of fingerlings was produced. The output of rainbow trout was considerably larger than usual. With regard to the production of pond fish, heavy rains retarded the distribution and probably cut down the output. Approximately 34,000 fry and fingerling largemouth bass were distributed, and it is estimated that about 20,000 remained in the ponds at the close of the year. An average production of rock bass and sunfish is expected. The station cooperated with other departments of the Government by furnishing large numbers of tadpoles to the Chemical Warfare Service at Edgewood, Md., and to the Pharmacological Service in Washington, D. C.

Manchester (Iowa) Station

(G. H. Gill, Superintendent)

Over twice the number of rainbow-trout eggs that were secured in the previous year were taken from the station brood stock this season. A particularly interesting occurrence was the production of a large number of eggs of the highest quality by the 2½-year-old trout. Operations with the smallmouth black bass and other pond species were not very successful. During the year 785,000 brook-trout eggs were procured from commercial hatcheries, but an epidemic of gill disease occurred among the resulting fingerlings. At the close of the year approximately 100,000 rainbow-trout fingerlings and 235,000 brook-trout fingerlings were on hand. The ponds for the warm-water fishes were lined during the season, and four new metal hatching troughs were added to the station equipment. Considerable work was accomplished in the construction of cement walks, steps, etc., and the pond system was improved by the construction of dikes and the building of cement supply cribs and outlets.

Neosho (Mo.) Station and Substation

(W. H. Thomas, Superintendent)

In December a special appropriation became available for making improvements to the Neosho station. The superintendent's residence was repaired extensively both inside and outside; the house was rewired and the interior refinished. Improvements were made to the annex building, also. The grounds were beautified by planting trees and flowers, the entrance approach was widened, and new concrete walks were constructed where needed. A diminution in the spring-water supply is ascribed to the clogging of the line with sediment. Some difficulty has been experienced with the drain lines from the ponds. Extensive improvements were made to the pond system.

The rainbow-trout brood stock was segregatde according to age, and it was found that eggs from the younger fish were of much better quality than the others. All rainbow brood stock over the age of 3 years was planted. Infection with the parasite gyrodactylus gave rise to considerable trouble among the fingerlings, but treatment served to bring it under control. The station distributed about 233,000 rainbow and Loch Leven fingerlings and handled several million eggs from the station brood stock and from Bourbon substation. There was a continuation of the difficulty arising through seepage from the ponds containing warm-water fish. It was attempted to make the ponds more productive by fertilizing them and allowing them to remain dry several weeks during the winter. The production of bass during the spring of 1928 was rather disappointing. Approximately 17,500 fingerlings were collected, but the muddy water rendered it impossible to determine how many more remained in the ponds. Rock bass, crappie, and sunfish also were handled, but it is evident that the production will be limited. Sixty adult channel catfish were transferred to the station in the hope that they would propagate. The majority were lost during the winter, and it was necessary to plant the rest in local waters.

Bourbon (Mo.) substation.—This cooperatively operated substation produced rainbow-trout eggs of good quality, the season's collection being the largest

since the bureau began to operate at this point. Parasitism by gyrodactylus caused trouble with the fingerlings at this substation. Heavy rains in June caused the water to rise and resulted in the loss of some fingerlings. It is possible, also, that a few of the larger fish escaped. At this station horse meat was fed instead of the usual sheep liver.

Langdon, (Mo.) substation.—The number of warm-water fish obtained from the ponds at this station exceeded that of the previous year, but it did not equal earlier records. This may be due partly to the fact that the ponds were flooded in August, during which time many fingerlings escaped.

White Sulphur Springs (W. Va.) Station

(Edward M. Haynes, Superintendent)

The year's work reached a new high level in the number of eggs and fish handled, which totaled 6,238,000 and was 1,416,000 in excess of the number handled in the previous year. No changes or expansions of importance were made to the plant. The painting of most of the buildings constituted the most important work in the way of routine maintenance. One cooperative trout nursery was operated under the supervision of this station. The usual cooperative arrangement with the State of West Virginia, whereby the bureau incubated over 1,000,000 eggs for the State in return for a share of the fry, was continued. Virtually all the brook-trout eggs handled were purchased or received by exchange. From the 2,400,000 received, 2,000,000 fish were had for distribution. Some feeding experiments with brook trout were conducted. The station has built up a brood stock of Loch Leven trout, which supplied over 375,000 eggs of high quality. A shipment of this species from the Bozeman (Mont.) field was handled for the State of West Virginia, and some were kept to meet the bureau's needs. The Loch Leven brood stock will be increased until it is large enough to take care of the needs of this station.

All rainbow-trout eggs were taken from the station brood stock, which has been built up so that it yields over 3,000,000 eggs. The eggs are secured from 2, 3, and 4 year old fish. The quality of the eggs was hardly up to that of former years, but a good output of fish for distribution was attained and a number of egg shipments were made, including four to Costa Rica, Peru, Switzerland, and Germany. A noteworthy carload shipment of 315 pails, carrying 465,000 fish, was made during the distribution of the fish belonging to the State of West Virginia.

The pondfish work was again affected by extreme variations in the weather. A moderate production of rock bass of the previous season's hatch was secured during the fall distribution. As has been the case for several years, there was no production of sunfish of any consequence in spite of every effort to secure them. The same unfavorable climatic conditions affected the production of bass, limiting the spring distribution to about 32,000 fish. It is believed that at least 20 nests were lost from this cause. It is hoped that a fair stock of fingerlings remains in the ponds.

Wytheville (Va.) Station

(C. B. Grater, Superintendent)

The usual work of keeping the station and grounds in good condition was done by the station force. This work would have cost about $2,000 if it had been performed by employees especially hired for the purpose. Considerable success attended the fish-cultural work, and an unusually large number of rainbow-trout eggs of high quality was obtained. The season's work was marked by the absence of an outbreak of octomitiasis, which usually appears during the spring. Consequently, an excellent stock of fry and fingerlings was obtained. An epidemic of octomitiasis attacked the yearling fish retained for brood stock. After thorough sterilization of equipment the trouble seemed to have been checked, but it was necessary to replace the lost fish with 3,000 from the Erwin (Tenn.) station. There was also some loss of adult brood fish during the spawning season due to an attack of furunculosis. Treatment with potassium permanganate served to abate this in some degree.

This station has engaged in the development of cooperative nurseries in conjunction with the State of Virginia, and several of these units were established and supplied with fish, while sites for several others were inspected. Fish

already distributed were from 80 per cent of the eggs collected, while 3.34 per cent remained on hand at the close of the year. The brook-trout eggs purchased from a commercial producer were unsatisfactory in that the losses of fry amounted to about one-third of the total number. Sufficient fingerlings were obtained, however, to meet the normal demands and to provide a small stock for several of the rearing pools adapted to this species.

Although the brood stock of largemouth bass was increased considerably, only a limited number of fish was produced, because climatic conditions were not right. Five thousand nine hundred fish produced in the previous year were distributed. The conditions affecting the largemouth variety also militated against a satisfactory production of the smallmouth form and likewise retarded the development of daphnia, which is food for the young. Only about 6,000 fish were distributed, but a number of fry were held over for distribution in the fall. A considerable number of rock bass were handled, as well as limited quantities of sunfish and catfish.

PONDFISH STATIONS

Some of the hatcheries in the Southern States again exceeded previous records. Pond stations, however, are particularly susceptible to unfavorable weather, which has reduced the output in several instances. The pond area has been extended and the water supply improved wherever possible.

Cold Spring (Ga.) Station

(Charles A. Bullock, Superintendent)

A number of the ponds at this station were enlarged, some were consolidated, while in others the old wooden overflows were replaced by a new device made of concrete. Several hundred feet of concrete flume, 3 feet in diameter inside, were constructed with the view of consolidating two of the ponds. A ditch leading to a highway culvert had been washed out, and it was necessary to construct a concrete flume to take its place. This flume is over 500 feet long, and the inside diameter is 4½ feet. Leaks in the water-supply system made other improvements necessary. Most of the station buildings were painted. All ponds were heavily limed during the winter, and as a result there has been a marked diminution in the growth of detrimental plants, and several of the ponds, which had been virtually worthless previously, produced a number of fish. While no new adult brood bass were secured during the year, the production was kept up by the addition of some cull stock and some young fish taken from the station rearing ponds. The year's output of largemouth bass was slightly less than 300,000.

The Harris substation was maintained as usual except that the former practice of feeding the adult fish was abandoned. By drawing the ponds down quickly and eliminating seining operations a very satisfactory production of bream was secured and at a much lower cost as compared with previous years. Due to the depredations of bass that escaped into one of the bream ponds, the production of bream at the main station was small, the yield being about 53,000 from the two ponds devoted to that work. A similar accident reduced the production of catfish, only about 7,000 fingerlings having been obtained from a brood stock of 100 adults.

Edenton (N. C.) Station

(W. S. Vincent, Superintendent)

A new wire fence was placed along the boundary of the station grounds adjoining the new State highway, which connects the hatchery directly with the town of Edenton. The electric-light line, formerly conducted under the creek by a submarine cable, was replaced by a line carried along the new highway. Considerable repairing of the station vessels was necessary to keep them in running order.

The fish-cultural work of the past season was quite successful, although the pondfish work did not produce as good results as could be desired. Small shipments of sunfish and crappie were made, but the bass work in the spring of

1928 was below normal, due to unfavorable weather conditions. The first collections of fry were made 30 days later than usual, and the spring shipments numbered only about 47,000. The fish were somewhat larger than usual, and it is expected that when the ponds are drawn in the fall it will be found that the production of fingerlings was satisfactory.

Louisville (Ky.) Station

(Charles W. Burnham, Superintendent)

This station, which is the bureau's chief agency for the propagation of smallmouth bass, was operated successfully, although the output of fish did not equal the record of some earlier years. It was found necessary to build a concrete foundation under the hatchery building in order to prevent the complete settling of the structure. The residence buildings were painted, and other minor improvements to the buildings were made. Some new concrete walks were laid, and the station roads and driveways were regraded and made passable in wet weather. This station had a brood stock of 100 adult largemouth bass, but the output of fingerlings, for some unexplainable reason, was very small. However, the brood stock of 400 adult smallmouth bass, divided among four ¾-acre ponds, produced over 500,000 fry and almost 5,000 fingerlings. While this does not constitute a record output, it is well up to the average. Efforts to augment the brood stock by transferring adults from Lake Erie were hindered by heavy mortality experienced shortly after the fish were received. The station has one pond devoted to the production of sunfish, but virtually every fish of this species was lost, due to an epidemic of some sort, which apparently was introduced with stock brought from the Mississippi River. A small number of rock bass was produced, and a few channel catfish were collected for filling applications.

Mammoth Springs (Ark.) Station

(Dell Brown, Superintendent)

Outside of painting and the construction of concrete floors and porches, few improvements were made to the buildings. One of the ponds was deepened and extended, and a new pond was virtually completed at the end of the year. The latter will be supplied from a new well by means of a pump capable of furnishing 100 gallons per minute.

Although an excellent stock of adult smallmouth bass was on hand, spawning was retarded by extremely unseasonable weather in the spring. A few nests established late in the spring produced about 68,000 fingerlings, approximately one-third the number that should have been obtained. A little better success attended the hatching of the largemouth bass, particularly those nests that lay in deeper water. About 66,000 fingerlings were shipped and 40,000 remained for fall distribution, a normal season's output. A satisfactory distribution of rock bass was made from the previous season's hatch. A brood stock of 100 sunfish also produced about 35,000 fingerlings for distribution.

This station engaged in rescue work in the overflowed area in Arkansas following the big flood. This work was carried on in cooperation with the State of Arkansas, and over 8,500,000 fish were returned to parental waters. At the close of the year the superintendent was detailed to supervise the construction of a large bass hatchery that is being established by the State of Arkansas.

Orangeburg (S. C.) Station

(G. W. N. Brown, Superintendent)

The most important improvement made during the year was the building of a concrete tank to hold fish before shipping them. The water was taken from a spring previously used for holding such fish, its flow having been increased materially by excavating. An electric pump was installed to pump water into a storage tank, which is to be utilized to increase the flow of water while the fish are being held.

Weather conditions were very unfavorable to the propagation of pondfishes. Fish hatched early in March apparently were killed by a sudden cold spell. Heavy rains in April increased the handicap, with the result that only 167,430

bass could be distributed. It is believed, however, that a considerable number of fingerlings remained in the ponds, which may be shipped later.

The fall distribution of bream was satisfactory, and many applications for them were filled. The brood stock was increased, and it is expected that the output from the spring hatch will come close to making a record for this station. A few warmouth bass, crappie, and catfish also were hatched and supplied to applicants.

San Marcos (Tex.) Station

(O. N. Baldwin, Superintendent)

At the San Marcos station many improvements were made during the year. The roof of the superintendent's residence was reshingled, and the interior was refinished. The foundation of the apprentice fish-culturist's cottage was reset, a new porch was built, some new roofing put on, and preparations were made to repaint it. The most important work was the reconstruction and enlargement of the ponds. Six ponds were consolidated or enlarged by deepening or raising the banks, by which several acres more of water surface were secured. A ditch was constructed and an embankment raised to prevent highway drainage from flooding the grounds and ponds. A new entrance gateway was constructed, and the piping in several ponds was relaid to provide individual connection with a concrete reservoir and improving the system materially.

A rack was started in a slough of the San Marcos River with the object of utilizing the area as a bass pond. It was necessary to remove considerable vegetation. The dwellings were wired for electric lights, and plans were made to extend this service to all the buildings as soon as possible.

A stock of brood bass was obtained from a fishing club in return for a stock of fingerling bass to be supplied later. The station has concentrated on the work of raising a larger number of fingerlings than heretofore, and the production of such fish increased approximately 30 per cent over earlier years. A smaller number of fish was obtained, but there were more cans of fish and more applications were filled. The output of sunfish has been reduced, due to lack of pond space. Few crappie are raised at the station, the majority being obtained from stock ponds in the adjacent country. The drying up of one of these ponds materially reduced the output during the past year. A brood stock of rock bass was reared at the station, and it appears that the spring hatch may permit a large output of fingerlings in the fall. Warmouth bass also are being produced in limited quantities. Other species handled were the green sunfish and the so-called Rio Grande perch.

New Braunfels (Tex.) substation.—This substation, sponsored by the town of New Braunfels, was moderately successful, having produced an output of almost 30,000 bass and sunfish.

Medina Lake (Tex.) substation.—This field station handles rainbow trout as well as pondfish. Due to the bad condition of the ponds, with attendant difficulty in holding water, the usefulness of the substation is questionable. The season's output was limited, and unless considerable work can be done in the way of reconstruction, it would be advisable to cease operations here.

Fort Worth (Tex.) substation.—At this station, which is newly established, five ponds have been built. This work required raising of over 1 mile of embankment. Several thousand feet of piping were laid, and the new banks were sodded with Bermuda grass. Heavy rains were detrimental to the latter work. At the close of the year there remained to be completed concrete outlets and intake boxes. The plant probably will be ready for the production of fish in 1929.

Tupelo (Miss.) Station

(Charles R. Wiant, Superintendent)

During the year three new ponds having a total area of 8.77 acres were put into use. With these ponds, the previous pond acreage of the station has been more than doubled. A new centrifugal pump connected with a new well 432 feet deep was installed for feeding the pond system, and by means of this equipment a water supply exceeding 500 gallons a minute was made available. A new pump house was constructed. A new heating system was

installed in the superintendent's residence, and minor repairs were made. The output of black bass exceeded the highest previous record by over 100,000. The year's distribution amounted to over 1,000,000, Tupelo being the first of the bureau's pond stations to attain this figure. Observations of the bass indicate that the age and vigor of the brood fish rather than the number available is the most influential factor in determining the output. It appears, however, that 50 bass to the acre is productive of the best results. Twenty thousand bass fry are being retained for fall distribution.

A number of reports were received indicating that plants of fry in new ponds gave very satisfactory results. Two species of sunfish were propagated in two special ponds and in the bass ponds, and 57,000 more than were needed to fill applications were obtained. A few warmouth bass and catfish also were handled. During the year, 728 separate applications were filled and a surplus of catfish was distributed.

A new substation at a leased pond near Aliceville, Ala., was established in the course of the year for the production of bass and sunfish, and a man was detailed there during the latter part of the year. The fish-rescue station at Friars Point, Miss., was in operation from July to October, and a somewhat larger number of fish than usual was handled, due to the terrific spring floods.

Lakeland (Md.) Ponds

[Under direction of Washington office]

The operation of these leased ponds was more successful than for several years past. All fish were distributed as fingerlings, and over 75,000 good-sized fish were secured from the five ponds comprising the tract. Approximately 30,000 of these were largemouth bass, and the rest were sunfish and crappie. The ponds were heavily stocked with golden shiners and goldfish as forage fish, and this abundant food supply brought about splendid growth as forage fish. At the conclusion of the distribution in late October, the ponds were left bare for the winter and the brood stock was increased to 525 bass, about 70 crappie, and 50 bluegill sunfish from the Mississippi River. These wintered well and were distributed in the various ponds in the spring. For some unknown reason spring spawning appeared to be limited, and the stock of fingerlings in the ponds at the close of the year was considerably smaller than in the summer of 1927.

CENTRAL STATION AND AQUARIUM, WASHINGTON, D. C.

[L. G. Harron, in charge]

For the benefit of the visiting public, efforts were made during the season to keep on hand a supply of the various species of fish eggs propagated by the bureau. These were from chinook salmon, rainbow trout, and cisco. A total of 1,396,275 of these eggs was received, and 1,320,000 fry obtained from them were distributed. The following fishes, produced at Lakeland, Md., and other stations or collected from the Potomac River, were received and distributed: 29,885 largemouth black bass, No. 3 fingerlings; 22,975 crappie, Nos. 2 and 3 fingerlings; 36,025 sunfish, No. 2 fingerlings; 16 adult smallmouth bass; 1,500 catfish, fingerlings No. 2; 265 yellow-perch yearlings; and 800 yearling roach. One thousand nine hundred and fifty-two fish of 35 species were exhibited in the aquarium during the year.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS

[E. C. Fearnow, Superintendent of Fish Distribution]

The output of the bureau's stations—7,036,317,200 fish and fish eggs—exceeded that of last year by over half a billion. Increased outputs were had of some of the most valuable species, such as the shad and cod. Over 71,000 more fingerlings were produced in 1928 than in 1927, also. The increased output of fingerlings represents 15,000 cans of fish, or approximately 30 carloads. To transport the entire output for the year would require nearly 125,000 regulation

containers, or 2,500 carloads. A large proportion of the fry and fingerlings were planted in waters in the vicinity of the hatcheries or released from the rearing stations into streams without resorting to shipment by rail. This is particularly true of the commercial species and rescued fishes.

Shipments of fish eggs were made to Costa Rica, Cuba, Ecuador, Germany, Peru, and Switzerland. About 95 per cent of the year's output consisted of eggs and fry of the commercial species, and virtually all of these, with the exception of the comparatively few furnished State fish commissions, were planted in the waters from which the eggs were obtained. Included in this classification are the glut herring, whitefish, cisco, salmon, pike, perch, yellow perch, carp, buffalo fish, cod, haddock, and winter flounder. The species distributed to interior waters are the brook trout, rainbow trout, black-spotted trout, and Loch Leven trout, the smallmouth black bass, largemouth black bass, crappie, rock bass, bream, and catfish. While the number of other fishes delivered represents but a small percentage of the entire output, at the time of shipment such fish were quite large and the distribution was a difficult problem. Fry of the commercial species are carried 50,000 to 100,000 to the pail, while not more than one hundred and fifty 3-inch fish can be carried in one of the regulation containers.

The trout distribution has become exceedingly heavy at the bureau's trout-producing stations, due to the establishment of a large number of cooperative nurseries in a number of the States. Small trout are delivered during May and June and are reared until they are 3 or 4 inches in length, when they are planted in suitable local waters. In addition to the general distribution to applicants during the spring and early summer, approximately 15 carloads of trout were delivered to cooperative projects in Pennsylvania, West Virginia, New York, Virginia, Minnesota, and Wisconsin.

The following table shows in summarized form the distribution of fish and fish eggs during the fiscal year to applicants in the United States and its territories. It also shows the plants of fish made by the bureau in public waters of the country in connection with the propagation of commercial fishes and the salvage of fish from temporary public lands.

Summary, by species, of the distribution of fish, fiscal year 1928

State and species	Number	State and species	Number
Alabama:		Arkansas—Continued.	
Catfish	920	Rainbow trout	37,400
Crappie	3,780	Crappie	1,850
Largemouth black bass	223,890	Largemouth black bass	91,715
Sunfish	72,875	Smallmouth black bass	35,000
Alaska:		Rock bass	42,200
Sockeye salmon	12,967,000	Sunfish	32,275
Brook trout	28,000	Yellow perch	100
Arizona:		California: Chinook salmon	6,559,700
Rainbow trout	6,000	Colorado:	
Brook trout	10,000	Catfish	8,000
Largemouth black bass	1,000	Rainbow trout	548,750
Sunfish	225	Black-spotted trout	254,600
Arkansas:		Loch Leven trout	206,000
Catfish	1,250	Lake trout	166,000
Buffalo fish	8,392,000	Brook trout	4,548,100

Summary, by species, of the distribution of fish, fiscal year 1928—Continued

State and species	Number
Colorado—Continued.	
Crappie	1,200
Largemouth black bass	3,695
Sunfish	555
Connecticut:	
Catfish	800
Loch Leven trout	3,000
Brook trout	9,500
Crappie	75
Largemouth black bass	3,585
Sunfish	6,900
Delaware:	
Rainbow trout	2,000
Loch Leven trout	102
Crappie	3,400
Largemouth black bass	88
Sunfish	50
District of Columbia:	
Rainbow trout	22
Loch Leven trout	5
Brook trout	33
Georgia:	
Catfish	6,515
Rainbow trout	65,500
Brook trout	24,750
Largemouth black bass	188,550
Rock bass	1,000
Sunfish	72,000
Idaho:	
Chinook salmon	7,349,500
Rainbow trout	63,300
Black-spotted trout	173,900
Brook trout	7,000
Illinois:	
Catfish	5,011,550
Buffalo fish	45,945
Carp	133,650
Brook trout	900
Pike and pickerel	1,240
Crappie	3,016,590
Largemouth black bass	13,230
Sunfish	2,841,306
Yellow perch	240
Miscellaneous fishes	3,289,500
Indiana:	
Catfish	7,800
Rainbow trout	21,200
Brook trout	28,010
Crappie	7,600
Largemouth black bass	18,310
Smallmouth black bass	163,600
Sunfish	14,250
Yellow perch	1,070
Iowa:	
Catfish	42,236,625
Buffalo fish	792,905
Carp	1,331,350
Rainbow trout	21,650
Loch Leven trout	25,000
Brook trout	90,700
Pike and pickerel	160,230
Crappie	6,866,240
Largemouth black bass	65,330
Smallmouth black bass	1,785
Sunfish	7,660,550
Yellow perch	37,265
White bass	4,920
Fresh-water drum	600
Miscellaneous fishes	761,510
Kansas:	
Rainbow trout	80
Largemouth black bass	2,575
Sunfish	600
Kentucky:	
Catfish	200
Rainbow trout	4,400
Crappie	1,480
Largemouth black bass	3,600
Smallmouth black bass	370,625
Rock bass	3,250
Sunfish	370
Yellow perch	120

State and species	Number
Louisiana:	
Catfish	612,000
Buffalo fish	682,605
Crappie	538,320
Largemouth black bass	256
Sunfish	500,450
Fresh-water drum	122,900
Miscellaneous fishes	6,400
Maine:	
Atlantic salmon	1,082,400
Landlocked salmon	441,540
Brook trout	1,915,980
Crappie	600
Largemouth black bass	1,350
Smallmouth black bass	26,296
White perch	1,200
Winter flounder	1,843,209,000
Maryland:	
Catfish	200
Shad	15,468,300
Chinook salmon	7,000
Rainbow trout	34,400
Loch Leven trout	400
Brook trout	111,700
Crappie	9,577
Largemouth black bass	6,986
Sunfish	9,240
Yellow perch	69,160,110
Massachusetts:	
Catfish	6,100
Rainbow trout	28,835
Loch Leven trout	1,000
Lake trout	8,200
Brook trout	187,300
Crappie	725
Largemouth black bass	4,575
Smallmouth black bass	8,500
Mackerel	5,212,000
Cod	884,008,000
Sunfish	5,000
Haddock	259,691,000
Pollock	138,373,000
Winter flounder	776,556,000
Michigan:	
Catfish	500
Whitefish	37,498,000
Cisco	875,000
Rainbow trout	185,000
Lake trout	23,217,000
Brook trout	684,050
Crappie	520
Largemouth black bass	1,960
Smallmouth black bass	43,070
Sunfish	4,040
Yellow perch	150
Pike perch	4,200,000
Minnesota:	
Catfish	5,222,200
Buffalo fish	2,045
Carp	220,320
Rainbow trout	97,750
Loch Leven trout	69,000
Lake trout	1,154,500
Brook trout	237,600
Pike and pickerel	255,218
Crappie	7,813,505
Largemouth black bass	66,950
Sunfish	9,810,970
Pike perch	3,480,000
Yellow perch	1,454,155
White bass	1,470
Fresh-water drum	500
Miscellaneous fishes	1,878,968
Mississippi:	
Catfish	2,217,765
Buffalo fish	462,125
Carp	742,200
Pike and pickerel	1,460,305
Crappie	1,017,590
Largemouth black bass	1,129,997
Warmouth bass	315
Sunfish	8,269,100

Summary, by species, of the distribution of fish, fiscal year 1928—Continued

State and species	Number
Mississippi—Continued.	
White bass	2,050
Yellow perch	1,440
Missouri:	
Catfish	1,732
Rainbow trout	512,274
Crappie	9,100
Largemouth black bass	14,539
Rock bass	2,000
Sunfish	13,465
Yellow perch	530
Montana:	
Rainbow trout	1,641,550
Black-spotted trout	3,376,250
Loch Leven trout	2,530,300
Brook trout	492,575
Grayling	725,000
Largemouth black bass	300
Nebraska:	
Rainbow trout	79,900
Loch Leven trout	21,000
Brook trout	171,000
Nevada:	
Rainbow trout	98,000
Brook trout	29,000
New Hampshire:	
Catfish	370
Landlocked salmon	15,175
Rainbow trout	57,280
Loch Leven trout	1,500
Lake trout	8,285
Brook trout	449,004
Largemouth black bass	4,450
Smallmouth black bass	5,000
Pike perch	600,000
Yellow perch	750,000
New Jersey:	
Catfish	500
Loch Leven trout	3,000
Brook trout	24,750
Crappie	1,050
Largemouth black bass	2,213
Smallmouth black bass	16
Sunfish	6,580
Yellow perch	175
New Mexico:	
Catfish	2,800
Rainbow trout	31,000
Black-spotted trout	900
Brook trout	44,000
Crappie	1,950
Sunfish	8,040
Yellow perch	1,825
Largemouth black bass	7,055
New York:	
Catfish	28,375
Whitefish	16,040,000
Cisco	85,950,000
Rainbow trout	40,200
Loch Leven trout	29,250
Lake trout	3,109,190
Brook trout	813,364
Crappie	3,160
Largemouth black bass	8,385
Sunfish	4,100
Pike perch	600,000
Yellow perch	2,801,310
North Carolina:	
Catfish	26
Shad	7,050,000
Glut herring	55,000,000
Steelhead salmon	27,742
Rainbow trout	285,307
Brook trout	227,000
Crappie	2,145
Largemouth black bass	80,806
Rock bass	13,535
Warmouth bass	200
Sunfish	19,875
Yellow perch	10,981,285
Striped bass	7,230,750
North Dakota: Loch Leven trout	4,900

State and species	Number
Ohio:	
Catfish	3,422
Carp	5,500,000
Whitefish	62,400,000
Rainbow trout	31,700
Loch Leven trout	4,000
Brook trout	52,000
Crappie	825
Largemouth black bass	6,634
Smallmouth black bass	9,000
Rock bass	679
Sunfish	11,075
Pike perch	160,000,000
Yellow perch	3,645,000
Oklahoma:	
Catfish	3,900
Rainbow trout	510
Crappie	9,050
Largemouth black bass	29,035
Rock bass	180
Sunfish	8,617
Yellow perch	190
Oregon:	
Chinook salmon	4,109,000
Silver salmon	1,369,500
Sockeye salmon	71,000
Steelhead salmon	261,000
Rainbow trout	125,000
Brook trout	537,400
Pennsylvania:	
Catfish	25,375
Cisco	1,300,000
Rainbow trout	192,150
Loch Leven trout	230,405
Lake trout	3,000
Brook trout	1,268,038
Largemouth black bass	26,625
Smallmouth black bass	7,640
Rock bass	34
Sunfish	16,380
Yellow perch	3,580
Crappie	9,782
Rhode Island: Black bass	150
South Carolina:	
Catfish	205
Rainbow trout	92,250
Brook trout	14,250
Crappie	170
Largemouth black bass	123,470
Warmouth bass	510
Sunfish	16,922
South Dakota:	
Catfish	5,000
Steelhead salmon	6,000
Rainbow trout	184,275
Loch Leven trout	63,800
Brook trout	805,670
Crappie	300
Largemouth black bass	3,745
Sunfish	5,650
Yellow perch	320
Tennessee:	
Catfish	1,800
Steelhead salmon	7,942
Rainbow trout	193,100
Brook trout	87,600
Crappie	3,330
Largemouth black bass	55,485
Smallmouth black bass	15,000
Rock bass	19,000
Sunfish	71,430
Yellow perch	300
Texas:	
Catfish	3,735
Rainbow trout	5,000
Crappie	6,776
Largemouth black bass	256,490
Rock bass	1,235
Sunfish	116,965
Utah:	
Rainbow trout	952,360
Brook trout	117,500

Summary, by species, of the distribution of fish, fiscal year 1928—Continued

State and species	Number
Vermont:	
Catfish	1,200
Landlocked salmon	36,639
Rainbow trout	26,000
Loch Leven trout	24,000
Lake trout	53,360
Brook trout	1,222,242
Largemouth black bass	150
Smallmouth black bass	1,700
Sunfish	2,250
Pike perch	44,740,000
Yellow perch	17,550,000
White perch	1,200
Virginia:	
Catfish	1,168
Shad	25,513,200
Rainbow trout	435,100
Loch Leven trout	22,000
Brook trout	231,085
Crappie	3,685
Largemouth black bass	151,052
Smallmouth black bass	10,800
Rock bass	24,000
Sunfish	3,575
Yellow perch	69,400,000
Washington:	
Chinook salmon	21,803,216
Chum salmon	22,609,000
Silver salmon	11,555,500
Sockeye salmon	15,950,600
Humpback salmon	2,387,080
Steelhead salmon	2,494,500
Black-spotted trout	51,200
Brook trout	365,500
Rainbow trout	77,500
West Virginia:	
Catfish	778
Rainbow trout	366,330
Loch Leven trout	212,200
Brook trout	797,400
Crappie	5,630
Largemouth black bass	13,360
Smallmouth black bass	3,000
Rock bass	400
Sunfish	4,938
Wisconsin:	
Catfish	31,814,506
Buffalo fish	335,000
Carp	1,412,185
Rainbow trout	266,300
Loch Leven trout	75,750
Lake trout	1,000,000
Brook trout	887,700
Pike and pickerel	3,237,806
Crappie	5,361,917
Largemouth black bass	35,628
Sunfish	4,550,085
Yellow perch	67,595
White bass	1,730
Fresh-water drum	138,500
Miscellaneous fishes	3,697,300
Wyoming:	
Catfish	4,600
Rainbow trout	1,161,100
Black-spotted trout	4,128,000
Loch Leven trout	103,050
Brook trout	1,130,425
Crappie	650
Largemouth black bass	1,765
Sunfish	390

METHOD OF DISTRIBUTION

In its distribution of fish, the bureau first considers the waters from which the eggs were obtained. After such waters have been properly stocked, fish are shipped to other suitable public and private waters. It is the aim of the bureau to apportion the output of its hatcheries so as to obtain the best results, giving special attention to depleted and nearly depleted waters in which it is apparent the fish would find suitable conditions for reproduction. Anyone desiring fish should communicate with his representative in Congress or write to the Bureau of Fisheries. The name of the water in which the fish are to be planted should be stated. Upon receipt of a request for fish, the bureau mails the applicant a blank on which the request may be made in a formal manner. These blanks call for a description of the waters to be stocked, and from the information furnished by the applicant the bureau can determine what species seems likely to produce the best results.

Applicants are notified immediately upon the receipt of their applications concerning the species that will be sent them and the approximate time the delivery will be made. They are also sent instructions for receiving and caring for the fish. Prior to the date of shipment a second notice is given, usually by telegram, stating the exact time the consignment will arrive at the railroad station indicated on the application. Deliveries of fish are made at the railroad stations of applicants without expense to them. However, applicants are required to meet the train with receptacles for receiving

the fish and to plant the consignment properly in the waters specified on the application.

The bureau has five specially equipped distribution cars that travel over the various railroads. Each car is equipped with cooling compartments, in which the fish are carried, and air compressors and pumps for forcing compressed air into the water to renew the supply of oxygen. Deliveries on the main lines of railroads as a rule are made direct from the bureau's distribution car while the train is making its customary stops.

Detached trips are made quite frequently from the distribution cars, each shipment being in care of an employee of the car. For example, a messenger leaves the car at a designated point with 25 or 30 pails of fish, proceeds to such places as can not be reached conveniently by the car, delivers 8 or 10 consignments of fish, and then

FIGURE 3.—Delivering fish to an applicant while the train makes its customary stop

returns to the car at some point farther down the line. As a rule, fish are delivered to applicants either by the bureau's distribution cars or by a messenger traveling in a baggage car.

Within recent years many fish have been delivered by automobile trucks to points within 50 or 60 miles of the propagating stations. Many of the States have adopted the bureau's method of transporting fish and have provided pails to replace the old-fashioned milk cans. The State of Pennsylvania has seven 2 to 3 ton heavily built trucks with bodies 12 by 6 feet. On each truck is arranged a double carrier forming an aisle through the middle, which permits the carrying of 80 pails of fish. The longest trips made by these trucks is 300 miles, a 15-hour drive, which is being done with perfect safety to the fish even during the hot summer months. The pail will carry fully as many fish as a 10-gallon can.

After loading a truck, if the weather is warm, the ice hopper of each pail is filled with ice and a tarpaulin cover put over the top of the truck. When an allotment is small and the applicant lives off the

main line of the railroad, the shipment is sometimes forwarded in care of the train baggage-master. In a few instances shipments are made by express.

In making allotments of fish on applications the bureau takes into consideration the area of water to be stocked, size and number of fish available for distribution, and the distance the fish can be transported. The fish are distributed by the bureau as fingerlings or yearlings. However, in some instances it is necessary to distribute a portion of the output before this stage is reached in order to prevent overcrowding. Pondfishes, such as bass and bream, are distributed from three weeks to several months after they are hatched. Basses usually range from 2 to 6 inches and sunfishes from 2 to 4 inches in length at time of delivery. The commercial species, such as whitefish and pike perch, are produced in large numbers and necessarily are handled as fry. As a general rule, the bureau delivers fish in the order in which the applications are received, and requests remain on file until delivery of the desired species can be made.

The bureau receives annually approximately 15,000 applications for fish, about 70 per cent of which ask for the so-called warm-water species such as bass, crappie, and bluegill, the remaining 30 per cent being for the various species of trout. While it is not difficult to meet the demand for trout, since they can be artificially incubated and fed on liver until they are large enough to be distributed or even until they have reached a legal size for catching, the situation with reference to the warm-water fishes is quite different, as they are nest builders and must be bred under nearly natural conditions.

Sudden changes in temperature during the breeding season and other factors over which there is no control make the output of a pond station uncertain. Moreover, the spiny-rayed fishes, especially the basses, are predatory in their habits, and when confined to small water areas where the amount of natural food is limited they will prey upon their own young.

The primary requirement for the production of pondfish is adequate pond space, and the bureau, with a total pond area of less than 200 acres, must spread the output of these ponds over hundreds of thousands of acres of open waters. It is therefore apparent that the bureau, with its limited facilities, can not furnish applicants many fish. In fact, the custom is to deliver merely the nucleus of a brood stock for waters in need of restocking, with the understanding that the fish will be planted and given an opportunity to reproduce. The bureau could not undertake to furnish enough fish annually to compensate for those taken by anglers, so after the fish are received by the applicant the work of conservation should begin, as no agency, either public or private, can successfully maintain good fishing in a body of water in which unrestricted fishing is allowed.

Delivery of fish to an applicant in a remote section of the country can not be made until a sufficient number of applications have been received from that section to warrant the expense of making a messenger shipment. Shipments of trout from the bureau's eastern stations are usually made during May and June, and applications received after March 1 are carried on file for attention in the following year. In the Rocky Mountain regions the distribution of trout from stations is made from May to October, and applications from

that section should be received prior to May 1 in order to assure early delivery. Requests for bass, sunfish, and crappie should be on file in the bureau prior to May 1, as deliveries of such species are made between May and December.

During the year the bureau's cars traveled 112,533 miles, of which 4,591 were free. Detached messengers traveled 298,065 paid and 87,420 free miles, a total of 498,018.

NEW DISTRIBUTION CAR

Reference was made in last year's report to the need for two distribution cars to take the place of cars Nos. 3 and 4. During the year the condition of car No. 4 became so bad that it was considered unsafe to keep it in commission. The matter of repairing this car was given careful consideration, and estimates were obtained from the Baltimore & Ohio and Pennsylvania Railroads relative to the cost of placing the car in safe condition for traveling. The Pennsylvania estimate was approximately $25,000. As the bureau did not feel justified in spending such a large sum on a wooden car with a carrying capacity only about 60 per cent as great as that of a new steel car, car No. 4 was placed on a siding at Lakeland, Md., and is being used as a home for the employees who operate the Lakeland Pond station.

An appropriation has been obtained from Congress for one new steel car, and its construction will begin early in the fiscal year with the view of having the car completed and ready for distribution work during the spring months. While the bureau needs two steel cars, the one allowed by Congress will be a valuable aid for the time being in the expeditious distribution of fish. However, in the interest of safety the operation of wooden cars in first-class trains should be discontinued as soon as possible. The remaining wooden car, No. 3, carries but 150 pails of fish, while a modern steel car will carry from 250 to 300 pails.

SHIPPING FISH BY AIRPLANE

On May 10 a shipment of 15,000 brook trout and 12,000 rainbow trout was made by airplane from Northville, Mich., to Dayton, Ohio. The fish were planted in streams of Wright Field. Lieut. George D. Tourtellot and R. E. Selff called at the bureau in the early spring and arranged to receive a shipment of fish for stocking the trout waters on the flying field at Dayton. A letter received from Lieutenant Tourtellot under date of May 22 reads as follows:

> We received our trout last week and brought them by airplane from Michigan to Dayton, Ohio, and deposited them in the streams at Wright Field. They came through in fine shape, and there was not a dead fish in the 20 cans when I landed here.

There are many inland streams that can not be properly stocked with fish due to lack of transportation facilities. In many sections of the West the United States Forest Service uses pack horses to transport fish from railroad stations to the headwaters of streams in the mountains. It is possible that in the future the airplane will be the means of taking more fish to streams than it will carry away.

EXPANSION OF WORK

The distribution from the rescue stations was delayed until about the middle of the fall months, but when the work of collecting began there were fish enough for distribution in large numbers, which necessitated quick action on the part of the distribution cars. At no time in the bureau's history were as many carloads of warm-water fish moved within a period of two months as were shipped during October and November, 1927. Fish were sent to virtually every State in the Union, and the cars were kept busy day and night for over two months. The fish distributed ranged in length from 3 to 8 inches. Had the collecting season remained open one week longer, the bureau would have been able to fill virtually every application

FIGURE 4.—Planting trout in a stream on Wright Field, Dayton, Ohio. The fish were transported by airplane from the bureau's hatchery at Northville, Mich.

for warm-water fishes it received. Rescue operations were discontinued late in the fall on account of the extremely cold weather.

A great deal of extra work and much additional expense has fallen to the distribution department on account of the extension of the bureau's activities. In addition to the general distribution to applicants, approximately 15 carloads of fish were required during the year for stocking cooperative nurseries. The expenses of distribution during the fiscal year were therefore considerably greater than last year's expenses.

DISTRIBUTION CARS

CAR NO. 3

(E. R. WIDMYER, Captain)

On July 5 car No. 3 made a shipment of rainbow trout and brook trout from La Crosse to Red Granite, Wis. Two car trips and a number of messenger shipments were made during the month of July, by which sixty-seven thousand

3-inch brook trout were delivered to cooperative nurseries and seventy-five thousand three hundred and fifty 3-inch brook trout and seven thousand eight hundred 2-inch rainbow trout to applicants.

During the latter part of July and first part of August the crew went over the Fearnow pails, cleaning and restenciling them. The aerating equipment and machinery also were gone over and placed in readiness for distribution work. The distribution of the warm-water species was begun on August 30, when a carload of bass, bream, and yellow perch was taken to Chicago and delivered to applicants in Wisconsin, Illinois, and Indiana. During September four car trips and a number of messenger shipments were made from the river stations to points in Wisconsin, Illinois, Indiana, Michigan, Pennsylvania, and Virginia.

The car left the Mississippi River stations on September 23 with a carload of warm-water species for Pennsylvania applicants. After completing the trip to Pennsylvania the car was ordered to Washington, D. C., to take up the distribution of fish from the Lakeland (Md.) ponds. The distribution work from the Lakeland ponds was completed late in October.

The car was in Washington from September 28 to October 22 and during this time delivered to applicants in New Jersey, Delaware, Virginia, West Virginia, Maryland, and Pennsylvania the following number and species of fish: Smallmouth black bass, 16 yearlings; largemouth black bass, 1,128 yearlings, 30 adults, and 22,250 fingerlings; crappie, 13,350 fingerlings; bream, 10,900 fingerlings; and rock bass, 1,850 fingerlings. The car left Washington October 22 for Harrisburg, Pa., with trout from the Camp Hill (Pa.) station. The car was ordered from Harrisburg to Bellevue, Iowa, to resume the distribution of warm-water fishes from the rescue stations.

From October 24 until late in November the car was busily engaged in the distribution of warm-water species to applicants in Wisconsin,, Minnesota, Pennsylvania, and New York. Heavy snowfalls in northern Wisconsin and Minnesota, together with severe cold weather, which froze over the lakes and streams, brought the distribution to a sudden close on November 29. The car was parked on a steam track of the Milwaukee Railroad at North Side, La Crosse, Wis., during the winter.

During January and February, while the car was not being used in distribution work, the crew made all necessary interior repairs, such as overhauling steam air compressor, water pump, laying new floors in office and wash room, relining ice box, repairing side partitions and deck sash, making new grates for ice box, removing old bronze and paint from water and steam pipes, cleaning sides and ceiling, repainting pipes in boiler room, bronzing pipes in wash room and body of car, painting kitchen-aisle floor, and varnishing interior of car, including chairs, tables, and office desk. The car was then placed in the Milwaukee shops for overhauling of trucks and making a few exterior repairs. The cost of repairs furnished by the shops was $195.61. The shop costs would probably have been $2,000 had the interior repairs been included. Upon the completion of the shop repairs the car was returned to La Crosse and its equipment placed in readiness for distribution. The pails were overhauled and restenciled, and the aerating equipment was changed to accommodate 200 pails.

On April 6 the car transferred 183,000 brook trout from La Crosse to Lynxville, Wis., returning to La Crosse on completion of the trip. The car left La Crosse on May 16 with twenty-seven thousand two hundred and fifty 3-inch fingerling rainbow trout, twenty-two thousand five hundred 3-inch fingerling brook trout, and fifteen thousand 2-inch Loch Leven trout for applicants in Wisconsin, Minnesota, and Michigan. On completion of this trip the car proceeded to Duluth, Minn., to take up the distribution of lake trout, pike perch, and rainbow and brook trouts. Eight car trips, five boat trips, and a number of messenger shipments were made from Duluth, delivering 11,085,000 lake-trout fry, 7,950,000 pike-perch fry, one hundred and ninety thousand 1-inch brook trout, and seventeen thousand two hundred and fifty 3-inch rainbow trout.

Immediately on completion of the Duluth distribution the car was ordered to La Crosse to make a distribution of trout to cooperative nurseries. During the last few weeks in June fifty-four thousand 3-inch rainbow trout, twelve thousand 3-inch brook trout, and three thousand one hundred and fifty 3-inch Loch Leven trout were delivered to cooperative rearing stations in Wisconsin.

During the fiscal year 1928 car No. 3 made 24 trips, traveled 16,664 miles, and delivered 20,866,219 fish. Messengers made 96 side trips and traveled approximately 30,000 miles. The following table shows the number, size, and species of fish delivered by the car and its crew.

Species	Fry	Fingerlings Nos. 1 to 6	Yearlings	Adults
Catfish		7,700		
Rainbow trout		109,500		
Loch Leven trout		18,150		
Lake trout	11,320,000	765,000		
Brook trout		553,775		
Crappie		35,075	5,100	
Largemouth black bass		55,200	1,128	210
Smallmouth black bass			16	
Rock bass		1,850		
Sunfish		23,090	16,370	
Pike perch	7,950,000			
Yellow perch		500	3,555	
Total	19,270,000	1,569,840	26,169	210

CAR NO. 4

(F. W. A. ENGELHARDT, Acting Captain)

From July 1, 1927, to June 30, 1928, car No. 4 distributed fish from the bureau's stations at Northville, Mich.; Leadville, Colo.; Neosho, Mo.; Bellevue, Manchester, and Marquette, Iowa; Homer, Minn.; La Crosse, Wis. and Lynxville, Wis. The car made 22 trips with fish, traveling 18,072 miles over 22 different railroads, and sent out 50 side trips, altogether delivering 1,413,229 fingerlings and 23,390 yearlings in 12 States. In addition to the above, 1,184 adult brood fish were moved between the bureau's hatcheries. The total cost of car travel was $6,663.01. The following table shows the species and numbers of fish delivered during the year:

Species	Fingerlings	Yearlings	Adults
Catfish	13,560		
Rainbow trout	211,625		
Black-spotted trout	24,000	10,400	
Loch Leven trout	20,000		
Brook trout	1,033,200	10,000	
Crappie	13,515	300	
Largemouth black bass	61,105	495	184
Rock bass	1,259		
Sunfish	34,370	760	1,000
Yellow perch	595	1,435	
Total	1,413,229	23,390	1,184

Besides the 50 side trips made from the car, its messengers made 30 trips with fish direct from hatcheries at a cost of $741.69. The following table shows the number, species, and size of fish the messengers thus handled:

Species	Fingerlings	Yearlings
Catfish	150	
Rainbow trout	319,100	
Black-spotted trout	72,300	35,500
Loch Leven trout	81,000	
Brook trout	1,075,500	
Crappie	200	
Largemouth black bass	4,925	
Smallmouth black bass	8,650	
Rock bass	1,200	
Sunfish	900	
Total	1,561,925	35,500

CAR NO. 7

(E. M. LAMON, Captain)

The distribution from the Upper Mississippi River collecting stations was taken up by this car on August 25, when 15,000 pondfishes were obtained from the Marquette and Bellevue (Iowa) stations for distribution to points in Iowa. From August 25 to October 28 the car made trips from the upper river stations to Waterloo, Iowa, St. Louis, Mo., Scranton, Pa., Indianapolis, Ind., Tuscaloosa, Ala., Albany, N. Y., and Nashville, Tenn., distributing 125,890 pond fishes. After completing the trip to Nashville the car proceeded to Tupelo, Miss., and obtained 57,000 fingerling bream, which were transported to Sheffield, Ala., and planted in Wilson Lake at Muscle Shoals.

On November 15 the car loaded at Lynxville, Wis., and proceeded to Syracuse, N. Y. A total of 15,980 pond fishes was distributed to applicants by messengers operating out of Syracuse. The car returned from Syracuse to Dubuque, Iowa, arriving at that point on November 21. On November 23 the distribution was brought to a close and the crew detailed to fish-cultural stations for the winter.

The car was placed in the Illinois Central Railroad shops at Chicago early in February, 1928, for repairs. The repair work was completed in March and the car returned to Dubuque, where part of the crew was assembled to assist in overhauling the car's equipment.

The spring distribution from the Manchester (Iowa) and La Crosse (Wis.) stations was taken up on May 8. On May 9, 300 adult black bass were forwarded from the Fairport (Iowa) station to Miles City, Mont., by one of the messengers from this car. During May and June two trips were made from Manchester, three from La Crosse, two from Lynxville, and one from Lincoln Park Aquarium at Chicago to points in Minnesota and Wisconsin. A number of detached shipments also were forwarded from La Crosse during May and June by messengers operating from the car. Fish were distributed from these stations as follows: Manchester, 224,000 brook trout and 55,400 rainbow trout; La Crosse, 173,100 brook trout, 45,500 rainbow trout, and 95,400 Loch Leven trout; Lynxville, 119,500 brook trout; Lincoln Park Aquarium, Chicago, 56,500 rainbow trout and 7,300 Loch Leven trout.

During the year the car made 18 trips and traveled 17,139 miles. Messengers operating from the car made 87 trips and traveled 17,724 miles. The numbers and species of fish distributed by the car during the year are shown in the following table:

Species	Fingerlings No. 1	Fingerlings No. 2	Fingerlings No. 3	Fingerlings No. 4	Fingerlings No. 5	Fingerlings No. 6	Yearlings
Catfish		27,700	4,200	12,000			300
Rainbow trout	111,900		45,500				
Loch Leven trout	32,200	70,500					
Brook trout		224,000	292,600				
Crappie		22,100	2,520			840	3,025
Large-mouth black bass		2,030	19,605	13,120	3,430	1,140	360
Sunfish	68,950	8,325	2,180	660			4,010
Yellow perch		200	1,600			320	555
Total	213,050	354,855	368,205	25,780	3,430	2,300	8,250

CAR NO. 8

(E. K. BURNHAM, Captain)

At the beginning of the fiscal year car No. 8 was at Nashua, N. H. Early in July a trip was made to Scranton, Pa., and one to Williamsport, Pa., the car proceeding from the last-named point to Northville, Mich. The distribution of trout and smallmouth black bass from the Northville station necessitated shipments to points in Indiana, Pennsylvania, and West Virginia. Upon completion of the Northville distribution the car proceeded to Watertown, N. Y., and took up the distribution of trout from the substation at that point, making shipments to various places in New York, Pennsylvania, and Vermont. The car

returned to Nashua for a load of trout, which was delivered to the bureau's cooperative station near Harrisburg, Pa.

After completing the trout distribution in the East the car proceeded to La Crosse, Wis., and Dubuque, Iowa, to assist in the distribution of fish from the Mississippi River collecting stations. Trips were made from the collecting stations to the following points: Engel, N. Mex.; Fort Wayne, Ind.; Conover, Wis.; Marinette, Wis.; Jersey City, N. J.; Williamsport, Pa.; and Louisville, Ky. At Louisville minor repairs were made to the car.

On February 19, 1928, the car left Louisville for White Sulphur Springs, W. Va., to take up the distribution of trout from that station. The first shipment was to Elkins, W. Va., with a load of 446,000 trout. From White Sulphur the car went to Wytheville, Va., where it obtained trout for applicants in the vicinity of Abingdon and Roanoke, Va., and Knoxville, Tenn. From Knoxville the car proceeded to Erwin, Tenn., and distributed three carloads of trout from that station to points in Tennessee, North Carolina, South Carolina, and Georgia.

Leaving Erwin with a load of yearling rainbow trout for delivery to the Wytheville station, the car proceeded to White Sulphur Springs, where a load of trout was taken on board for distribution en route to Washington, D. C., and various points in Maryland, Pennsylvania, and West Virginia. The car returned to Washington on April 9, where minor repairs were made. Upon completion of the repairs the car returned to White Sulphur Springs and obtained a load of trout and proceeded to Great Barrington, Mass., distributing its cargo en route to applicants in Pennsylvania, New Jersey, and Connecticut.

A carload shipment of trout was moved from the Berkshire station near Great Barrington to the bureau's cooperative nursery at Windber, Pa., the car then proceeding to Nashua, N. H., where it made a shipment of trout to Portland, Me., proceeding from Portland to Bucksport, Me., where 8 carload shipments of trout and salmon were made from the Craig Brook (Me.) station to points in the State of Maine.

During the fiscal year the car made 35 trips and traveled 23,737 miles. Detached messengers made 127 trips and traveled 30,079 miles. Altogether, 1,950 applications were filled. The distribution carried the car or its employees into the following States: Maine, New Hampshire, Vermont, New York, Pennsylvania, Michigan, Wisconsin, New Mexico, Texas, Illinois, Ohio, Kentucky, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Maryland, New Jersey, Connecticut, and Massachusetts. The following table shows the number and size of the species delivered during the year:

Species	Fingerlings No. 1	Fingerlings No. 2	Fingerlings No. 3	Fingerlings No. 4	Fingerlings No. 5	Fingerlings No. 6	Yearlings and adults
Catfish		700	13,000	9,125			
Atlantic salmon	1,073,500						
Rainbow trout	529,000	372,200	17,000				3,000
Loch Leven trout	110,000	16,950					
Lake trout		23,500					
Brook trout	1,458,100	1,014,750	476,000		1,700		
Crappie		3,190	700		840	6,710	
Largemouth black bass			4,700	11,555	1,705	210	75
Smallmouth black bass	34,740						
Sunfish		6,900	1,980	3,450	9,615	50	
Yellow perch				1,050	210	260	3,045
Total	3,205,340	1,445,190	513,380	25,180	14,070	7,230	6,120

CAR NO. 9

(H. F. JOHNSTON, Captain)

On July 1 the car was ordered to proceed from Chicago to Manchester, Iowa, for the purpose of obtaining a load of brook trout and rainbow trout, which were assigned to applicants in Wyoming. The car left Manchester on July 5 and upon completion of the Wyoming distribution continued to Bozeman, Mont., to handle the output of trout from the bureau's hatchery at that point. The car arrived at Bozeman on July 9, and left on the same day with a special shipment of brook trout assigned to the various streams of the Glacier National

Park. During July car trips were made to Lander, Wyo., Lewistown, Missoula, Billings, and Gardner, Mont., and a second trip to Glacier Park.

The black-spotted trout distribution from Bozeman was about a month later than the rainbow-trout and brook-trout distributions, and as the latter were completed by the last of July the car was detailed to assist the Montana Fish Commission with its distribution of trout pending the development of the black-spotted trout fry. The distribution for the Montana Fish Commission continued throughout the month of August and was completed by September 2. Besides handling eight carloads of trout from the various Montana State hatcheries, the car moved one carload of trout for the Idaho State Fish Commission from Ashton to St. Maries, Idaho. The car returned to Bozeman on September 7 and at once took up the distribution of the black-spotted trout, completing the work by October 4.

Returning to Dubuque, Iowa, on October 11, the car loaded with warm-water fishes and left at once for Denver, Colo., supplying warm-water fishes to applicants in Wyoming, Colorado, and New Mexico. Carloads of the same sort of fishes were distributed to applicants in Massachusetts, New York, Connecticut, Vermont, New Hampshire, Maine, Rhode Island, Minnesota, Wisconsin, and Pennsylvania, the destination of the trips being as follows: Springfield, Mass., Ashland, Wis., St. Paul, Minn., Harrisburg, Pa., and Washington, D. C. The fall distribution was completed by December 10, after which members of the crew were detailed to the bureau at Washington and to stations in the field. Annual repairs to the car were made at the Pennsylvania Railroad shops at Wilmington, Del., during January.

The spring distribution for 1928 was taken up on March 10, at which time the car was detailed to the White Sulphur Springs (W. Va.) station. From March 10 until June 10 the car remained on the White Sulphur Springs distribution and during this time handled 12 carloads of trout, supplying applicants in Pennsylvania, Virginia, West Virginia, and Maryland. Upon completion of the White Sulphur Springs distribution the car made one carload shipment for the Maryland Conservation Commission. After the Maryland distribution the car returned to Washington, D. C., and remained there until the close of the fiscal year.

During the fiscal year the car made 46 trips, traveling 32,330 paid miles and 4,591 free miles. It handled 5,206,713 fish, delivering 3,651,676 directly to the applicants, and the remaining 1,555,037 were carried by detached messengers from the car to the applicants. The messenger distribution amounted to 139 shipments. To complete the distribution necessitated the movement of 9,063 Fearnow pails and two hundred and seventy 10-gallon cans of fish. During the year the car filled 2,314 individual applications widely scattered in 29 States. The number and size of fish delivered by the car and its screw during the past fiscal year are shown in the following table:

Species	Fingerlings No. 1	Fingerlings No. 2	Fingerlings No. 3	Fingerlings No. 4	Adults
Catfish		12,000	21,000		
Rainbow trout	968,400	88,200	46,000	475	
Black-spotted trout	2,185,470			4,000	7
Loch Leven trout	193,400	29,250			113
Brook trout	363,000	814,175	395,425		24
Grayling					30
Crappie		1,500			10,814
Largemouth black bass			11,625	3,935	1,435
Sunfish	25,625		1,995	720	15,330
Yellow perch				600	320
Miscellaneous fishes		11,775			70
Total	3,735,895	956,900	476,045	9,730	28,143